THE MELANOPLI OF KANSAS.

A THESIS

SUBMITTED TO THE DEPARTMENT OF ENTOMOLOGY AND TO THE GRADUATE FACULTY OF THE UNIVERSITY OF KANSAS IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS.

by

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Introduction.

This paper is the result of about two years study of the group of Grasshoppers known as the Melanopli, belonging to the subfamily Acridiinae. This group contains a large number of species of grasshoppers and includes nearly all of those of economic importance. The group is represented in Kansas by the following genera, Hypochlora, Campylacantha, Hesperotettix, Aeoloplus, Melanoplus, and Phoetaliotes. Thirty-nine species are recorded here and are distributed under the six genera as follows:

Hypochlora - 1

Campylacantha - 3

Hesperotettix - 3

Aeoloplus - 2

Melanoplus - 29

Phoetaliotes - 1 species (two var.)

The taxonomic side of the paper is based largely upon material collected during the summers of 1910, 1911, and 1912, by the Kansas University Entomological Expedition while collecting material for the museum in central and western Kansas. A lot of material was also collected

during the summers of 1913 and 1914 while the writer with five other members of the Department of Entomology of the University was engaged in organizing the various counties for campaigns against the native destructive grasshoppers in Kansas.

The Economic and biologic phases of the paper are based upon observations made at the time when economic work was carried on in the western part of the state.

The aim of this paper has been to prepare a treatise on the Melanopli of Kansas which would, to some extent treat the taxonomic, economic, and biologic phases concerning this important group of grasshoppers. The greater number of species studied have come from central and western Kansas, and subsequent collecting in the eastern and southeastern part of the state will undoubtedly reveal a number of species belonging to this group, not treated in this paper.

The Keys to the genera and species have been modeled after Scudder's keys; the description of the group and the genera have been copied from Scudder directly. In the discussion of the species the variations of the Kansas species from Scudder's description have been given. In recording the measurements the largest and smallest specimens were taken and their measurements recorded respectively.

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Melanopli.

The Melanopli are Acridians in which the antennae are longer than the fore femora, which have no foveolae on the vertex, the fastigium more or less deflexed, passing insensibly into the frontal costa, the prosternum mucronate, no sharp and distinct lateral carinae (or they are rarely present), an arolium on all the tarsi, the hind tibia with smooth margins, provided with 9-14 (by rare exceptions 8) spines regularly disposed in the outer series, which lacks an apical representative, and the second hind tarsal joint only half as long as the first.

Stating their characters more in detail, the Melanopli may be described aw Acridian, generally of small or medium size, never very large, in which the head is not greatly exserted and the face is moderately oblique or subvertical; the antennae are linear, longer than the fore femora; the eyes are of moderate size, not very strongly prominent, never twice as long as the infraocular portion of the genae, the interspace between them very rarely broad, generally narrow; the fastigium is more or less declivent,

never greatly produced in the axis of the body, opically entire and with no transverse ruga, passing insensibly and with obtuse arcuation into the frontal costa; the latter is hardly rounded as seen from the side, percurrent or subpercurrent, generally sulcate, the sulcation ordinarily confined to the lower portion; without foveolae, the tempora small, obliquely declivent, confused with the front; the superior ocelli more distant than the antennal scrobes; the lateral carinae of the face nearly equidistant from the lateral margins of the frontal costa, but slightly divergent inferiorly. The dorsum of the pronotum is nearly plane and without a crest, generally with no distinct lateral carinae, but at most with rounded shoulders or feeble rugae to represent them, but often passing insensibly into the lateral lobes; the principal sulcus is continuous; the prozona is generally smooth or obsoletely punctate, never tuberculate, its sulci generally feebly impressed, often mesially interrupted or subinterrupted, the posterior sulcus often distinctly divergent laterally from the principal sulcus; the metazona is generally shorter than the prozona and lies in the same or nearly in the same plane with it, almost always densely punctate;

the lateral lobes are truncate or subtruncate posteriorly, with no humeral sinus or only a feeble one, the posterior lower angle distinctly obtuse. The prosternum is armed with a spine which is usually rather prominent and conical, sometimes truncate, never sinuate, generally vertical on the posterior face, nearly or quite as high as the anterior coxae, the posterior portion of the prosternum not or but slightly tumescent; the mesosternal lobes are quadrate or transverse, separated more or less widely, the apical inner angle rectangulate or obtusangulate, generally rounded (often obtusely), the inner margins generally rounded, often posteriorly divergent; the metasternal lobes are contiguous or not very distant excepting sometimes in the female and then rarely as distant or even nearly as distant as the metasternal lobes. The tegmina are frequently abbreviate or even wanting; when fully developed, they taper gently almost throughout and are rather remotely reticulate at least in their apical half, the cells of the postradial area wholly or partially biseriate in arrangement on either side of an intercalary vein; the wings are almost always clear and uniform, never definitely pictured, the

veins never scalariform, the areolae quadrate or longer than broad. All the tarsi are furnished with an arolium, the front legs are less distantly separated than the hind pair, the fore tarsi are of moderate length, first joint short or rather short; the hind femora are distinctly incrassate basally, generally surpass the abdomen, the upper face generally smooth, the dorsal carina entire, unarmed, not profoundly excised before the geniculation; the hind tibia have smooth lateral margins, the spine of the outer and inner series are equal or subequal in length, those of the outer series typically nine or more in number, rarely exceeding fourteen, placed at subequal distances apart and lacking an apical spine next the calcaria; the hind tibia have the first joint not compressed equal to or slightly longer than the third, the second much shorter, generally a half shorter, than the first as seen from above. The second dorsal segment of the abdomen is neither granulate nor dentate at the anterior angles, the extremity of the abdomen of the male generally more or less clavate and removed, the supra-anal plate not tuberculate, with a basal median sulcus,

a furcula usually present, the cevei very variable, rarely longer than the supraanal plate, straight or gently curved, never abruptly recurved basally, generally compressed at least in part, often but with no indirected median spine.

S. H. Scudder.

Key to the Genera of Melanopli.

A^1. Lateral margin of subgenital plate of male, as seen laterally, straight thruout, or very slightly convex, never at all abruptly ampliate at the base; tegmina always abreviate.

b^1. Head not prominent, the summit very slightly arched longitudinally; prosternal spine erect; furcula of male composed of projecting cylindrical fingers; surface of body feebly pilose. Hypochlora.

b^2. Head prominent, the summit strongly arched longitudinally; prosternal spine more or less retrorse; furcula of male reduced to slight, scarcely projecting lobes; surface of body rather densely pilose. Campylacantha.

A^2. Lateral margin of subgenital plate of male suddenly ampliate to a considerable degree at the

A base, or if not to a considerable degree, then the entire margin rather rather strongly convex or sinuate.

b^1. Subgenital plate of male furnished with a distinct subapical tubercle (i.e. one in which the apical margin does not pass thru and form part of the summit of the tubercle, but where it is distinctly separate from that summit), but not otherwise tumescent.

$c^{2/}$. Body relatively slender and compressed, not much enlarged at the metathorax, particularly in the male; disk of pronotum tectiform, the prozona not distinguished from the metazona either by its plane or by any lack of the median carina, which latter is generally marked in color; pronotum fully half as long as broad; hind femora long and slender; apical tubercle of male abdomen prominent; furcula present as distinctly projecting lobes; terminal segment of female abdomen not abbreviate, the ovipositer fully exerted.

Hesperotettix.

c^2. Body relatively short and stout, considerably enlarged at the metathorax, even in the male, disk of pronotum gently convex transversely, the prozona slightly and independently tumid with no median carina, thus distinguishing it from the metazona; hind femora relatively short and stout; apical tubercla of male abdomen not very prominent; furcula scarcely or not apparent; terminal segments of female abdomen abbreviated, the ovipositer only partially exerted.

Aeoloplus.

b^2. Subgenital plate of male with no distinct subapical tubercle, but often apically prolonged or tumescent.

c^1. Head not large in proportion to pronotum, not prominent, but little longer above than prozona except when the latter is transverse, the intercallary veins of the discoidal area rather numerous. Cerci of male very variable.

Melanoplus.

c^2. Head large in proportion to pronotum, and prominent, nearly half again as long above as the

prozona. Interoallary veins few and indefinitely marked; cerci of male styleform; subgenital plate of male very narrow.

Phoetaliotes.

Hypochlora.

Body slender, compressed, very thinly pilose. Head not prominent, the summit gently arched, the fastigium descending with moderate rapidity, the face retreating considerably; interspace between the eyes broad, the fastigium scarcely sulcate, the frontal costa rather narrow, not nearly so broad as the space between the eyes, sulcate, percurrent, and subequal; eyes moderate in size, not very prominent, similar in the two sexes, about half again as broad as long, and distinctly longer than the anterior infraocular portion of the genae; antennae moderately stout, somewhat longer (male) or a little shorter (female) than the head and pronotum together. Pronotum subequal, even in the female, very feebly and gradually enlarging in passing backward, with a distinct percurrent median carina, the disk very broadly subtectate, passing by a rounded angle hardly

forming a lateral carina into the vertical lateral lobes, the front subtruncate, the hind angle very obtusely angulate, the very coarsely, feebly, and sparsely punctate prozona half again as long as the finely and suddenly punctate metazona, its posterior margin faintly angularly emarginate, the transverse sulci feeble, one dividing into two equal halves and straight, the other a third the way behind it to the metazona and sinuate. Prosternal spine erect, moderately slender, conical; interspace between mesosternal lobes more than twice as long (male), or nearly half as long again (female) as its middle breadth, the shape being strongly cleysydral from the convexity of the inner margin of the lobes, the metasternal lobes subattingent, especially in the male. Tegmina abbreviate, acuminate, attingent or overlaping, about as long as the pronotum. Fore and middle femora slightly tumid in the male; hind femora slender, somewhat compressed, the lower genicular lobe not free from markings, the hind tibia with nine to ten spines in the outer series. Abdomen of male not clavate nor turned upward apically, the lateral

margins of the subgenital plate straight from the very base, acutangulate at tip, with a slight, blunt, apical tubercle; cerci very slender and simple; furcula consisting of a pair of slight cylindrical slender fingers, subparallel or more or less crossing one another, perhaps parallel in life.

S. C. Scudder.

Hypochlora alba. Dodge.

Whitish to yellowish green, rather small, the head with a pallid stripe from the upper margin of the eye backward, extending in the paler forms across the entire pronotum and downward on the pleura of the metanotum. An olivaceous postocular band extends backward over the entire pronotum; the antennae of the darker forms are ferruginous except at the extreme base where they are somewhat paler. The median and lateral carina are marked by narrow yellowish stripes becoming white in the pales forms; tegmina pale grass green to testaceous; the sulcus which divides the median ridge of the supraanal plate fails to reach the tip in some cases.

Measurements.

Length of body,	male	17 - 18.5 m.m.
	female	20 - 24 m.m.
Tegmina	male	4.5 - 7 m.m.
	female	6 - 6.5 m.m.
Antennae	male	7 - 8 m.m.
	female	6 - 7.5 m.m.
Hind femora	male	11 m.m.
	female	13 m.m.

Localities.

Finney, Rooks, Sedgwick, Russel, Clark, Lane, Stevens, and Douglas Counties.

This species is rather common in the state and is usually found among the Chenepodiaceae.

Campylacantha. Scudder.

Body somewhat compressed, rather densely pilose. Head rather prominent, especially in the male, the genae being rather tumid and the summit strongly arched and distinctly elevated above the level of the pronotum, the fastigium descending rapidly, but the face moderately retreating; interspace between the eyes rather broad (male) or broad (female), the fastigium feebly if at all sulcate, the frontat costa distinctly broadest between the antennae, where it is

nearly as wide as (male) or still much narrower (female) than the interspace between the eyes, percurrent, sulcate at least below the ocellus; eyes not very prominent nor very large, longer in proportion to breadth in female than in the male, and yet in the female hardly, in the male distinctly, longer than the anterior infraocular portion of the genae; antennae rather coarse, more than half as long as the body of the male, distinctly longer than the head and pronotum together in the female. Pronotum subequal (male) or distinctly and very gradually broadening posteriorly (female) with a rather slight median carina, sometimes interrupted between the sulci, the disk very broadly subtectate, passing by a rounded angle, without forming lateral carina, into the vertical (male) lateral lobes, the front margin subtruncate, in no way flaring, the hind margin obtusely angulate, the impunctate or very feebly rugulose prozona nearly or quite half again as long as the punctate or distinctly rugulose metazona, its transverse sulci moderately distinct, that in the middle straight, and followed a third of the way to the metazona by a similar but arcuate sulcus.

Prosternal spine blunt conico-cylindrical, more or less retrorse; interspace between mesosternal lobes nearly twice as long (male) or half as long again (female) as broad, the inner margins of the lobes nearly straight; metasternal lobes attingent (male) or subattingent (female). Tegmina abbreviated, generally but not always a little longer than the pronotum, rounded or subacuminate at tip, their inner margins overlapping or separated. Fore and middle femora distinctly gibbous in the male; hind femors variable, as also the coloring of the inferior genicular lobe; hind tibia with nine to ten, generally nine, spines in the outer series. Abdomen of male very feebly clavate, very feebly upturned, the lateral margins of the subgenital plate not ampliate at the base, the apex bluntly angulate at tip, with a distinct but not very large tubercle, extending beyond the inner side of the apical margin; furcula consisting of a pair of slight rounded, feebly projecting lobes.

This genus is closely allied to Hypochlora, but is composed of generally stouter forms, in which the antennae are longer, the pronotum is usually rugulose

rather than punctate, and the males of which have more tumid anterior femora, besides the differences pointed out in the table of genera.

L. C. Scudder.

Key to the species of Campylacantha.

A^1. Distal half of anal cerci of male less than half as broad as the extreme base.

b^1. General color griseous, sometimes a slight greenish tinge hind tibia livid, finely flecked with griseous. acutipennis.

b^2. General color olivaceous; hind tibia yellowish green. olivacea.

A^2. Distal half of anal cerci of male more than half as broad as the extreme base. vivax.

Campylacantha acutipennis. Scudder.

Our specimens agree remarkably well with Scudder's description, and vary only slightly as follows. Antennae pale yellowish testaceous sometimes becoming infuscated at the extreme tip; median carina distinct

the lateral carina more distinct on the metazona than on the prozona.

Measurements.

Length of body,	male	20 m.m.
	female	24 - 27 m.m.
Tegmina	male	7 m.m.
	female	8 - 10 m.m.
Antennae	male	10 m.m.
	female	9.5 m.m.
Hind femora	male	11.5 m.m.
	female	15 - 16 m.m.

Localities.

Douglas, Lane, McPherson, Labette, Shawnee, and Barber Counties. Found along road sides and in the grasses.

Campylacantha olivacea. Scudder.

General color varies from rather bright to dark olivaceous green. The antennae are greenish at the base, sometimes mottled with brown, beyond the base they are orange to ferruginous, infuscated at the tip. The darker forms have very little of the lemon-yellow marking on the pronotum; pronotum dusky. Legs yellowish green to dark olivaceous, rarely tinged with orange; cerci slender, feebly incurved, the apical half about half as broad as the basal half.

Measurements.

Length of body,	male	18 - 20 m.m.
	female	23 - 30 m.m.
Tegmina	male	5 - 8 m.m.
	female	8 - 9 m.m.
Antennae	male	10.5 m.m. (approx.)
	female	10.5 m.m. "
Hind femora	male	12.5 - 13 m.m.
	female	16 m.m.

Localities.

Lane, Clark, Douglas, Sedgwick, and Rooks Counties. The habitat of this species is very much the same as that of acutipennis.

Campylacantha vivax Scudder.

Size medium; general color yellowish green with brownish markings. Head with a narrow longitudinal brown stripe on top bordered broadly on each side with dark olivaceous. Frontal costa subequal, sulcate at and below ocellus, fastigium very shallowly sulcate; antennae dark ferruginous, infuscated in apical two thirds. Pronotum nearly as wide as head, feebly enlarging posteriorly, dorsum rather convex; prozona about a third longer than metazona. Median

carina more distinct on metazona than on prozona cut by the principal sulcus, the lateral carina with a short yellowish brown stripe; prozona sparsely punctate metazona profusely punctate becoming rugulose, anterior margin truncate posterior margin obtusely angulate. Prosternal spine rather stout, bluntly pointed, appressed. Tegmina sublanceolate, about as long as the pronotum; wings rudimentary. Hind femora greenish yellow, befasciate above with olivaceous and with a whitish stripe on outer lower margin. Hind tibia blue, the spines blue with black tips ten in number in the outer series; orolium large. Supraanal plate of male triangular, as wide as long apically acute angulate with median sulcas extending nearly one half the length of the supraanal plate. Furcula consisting of a pair of minute lobes; cerci nearly straight, failing to reach the tip of supraanal plate by one half their length, distal half more than half as broad as basal half, tip produced below.

Measurements.

Length of body	male	19.5 m.m.
	female	24.5 m.m.
Tegmina	male	5.5 m.m.
	female	6.25 m.m.

Hind femora	male	11.5 m.m.
	female	14 m.m.
Antennae	male	8.5 m.m.
	female	_____

One male, two females. Morton County, Kansas, August 5, 1911. F.X.Williams.
Now first recorded from Kansas.

Hesperotettix. Scudder.

Body almost parallel-sided, very little enlarged at the metathorax, more or less but not generally compressed, more so in the male than in the female. Head not very prominent; vetex usually very narrow between the eyes, with a slight depression or sulcation between; fastigium broadening in front of it, declivent, with a median depression or longitudinal sulcation, sometimes distinct, sometimes obscure, the sides rounded; front straight, somewhat oblique, the frontal costa equal, only slightly contracted at the extreme summit, generally as broad as if not broader then the interval between the eyes, sulcate throughout; antennae slightly (female) or considerably (male) longer than the head and pronotum together; eyes slightly prominent, a little more so

in the male than in the female, rather long oval, much longer than the infraocular portion of the genae. Pronotum long and slender, the dorsum fully half again as long as broad, the prozona little longer, sometimes half again as long as the metazona, with less distinction in surface and sculpture between them than common, alike broadly tectiform, the median carina slight but alike or nearly alike in both, the descending lateral lobes separated by no angle or ruga; posterior margin very obtusely angulate, the angle rounded, the border delicately margined. Prosternal spine rather long, bluntly conical; meso- and metastethia together much longer than broad; interspace between mesosternal lobes generally twice as long as broad in the male, almost equally narrow or subquadrate in the female, the metasternal lobes subattingent in both sexes. Tegmina and wings always present, generally fully developed or abbreviate, but sometimes lobate. Fore and middle femora of male tumid; hind femora long and slender, somewhat compressed, generally surpassing the abdomen, the superior carina slight, un-

armed; hind tibia feebly ampliate apically, with spines of similar length on the two sides; first joint of hind tarsi scarcely longer than the third, the second small, with a large inferior apical lobe; arolium rather large, nearly twice as long as broad. Subgenital plate of male furnished with a prominent, subapical, more or less conical tubercle, the lateral margins of the plate suddenly ampliate at the base; furcula always distinctly present as a pair of projecting lobes; last abdominal segment of female not abbreviate, the ovipositor normally exerted.

This genus is closely related to Hypochlora and Campylacantha, but is separated from them by the basal ampliation of the margins of the subgenital plate of the male. The genus is still more closely allied to Aeoloplus, from which it is separable by the form of the pronotum and the slenderness of the body.

S.C.Scudder.

Key to species of Hesperotettix. ~~Scudder~~.

A^1. Metazona of pronotum distinctly punctate on dorsum but not rugulose, prozona smooth.

b^1. Dorsum of pronotum nearly plane, transverse sulci of pronotum distinctly marked in black.

viridis.

b^2. Dorsum of pronotum tectiform, the transverse sulci not marked in black or in strong contrasting colors.

pratensis.

A^2. Prosona and metazona, both on dorsum and lateral lobes equally and distinctly rugulose.

speciosus.

Hesperotettix viridis. Thos.

The infraocular bar and the infraantennal band vary from olivaceous to black, the infraantennal band being absent in some of the specimens, while in others it forms a wide band reaching from the eye down to the clypeal suture. Longitudinal stripe of vertex olivaceous to black; sides of head behind the eyes streaked longitudinally with darker colors, sometimes becoming a broad olivaceous to black postocular band. Mediodorsal stripe white to ochraceous, or sometimes the stripe is ochraceous on the prozona and

white or greenish white on the metazona. Lateral lobes of prozona variegated by an irregular assortment of brief longitudinal dark green, rarely black bars. The greenish tinge on the antennae sometimes extends to the middle on the antennae, becoming yellowish in the middle and testaceous from the middle toward the end. In most cases the cerci of the male taper all the way to the tip. This species looks very much like H. festivus but the transverse markings are more strongly contrasted, the pregenicular annulation is more distinct; the tegmina are a little wider not tapering as much.

Measurements.

Length of body,	male	16-21 m.m.
	female	18-28 m.m.
Tegmina	male	11 - 16 m.m.
	female	16 - 22 m.m.
Antennae	male	8 - 9 m.m.
	female	8 -10 m.m.
Hind femora	male	8.5 - 12.5 m.m.
	female	14 - 16 m.m.

Localities.

Stanton, Grant, Sherman, Trego, Seward, Russel, Stevens, Wichita, Norton, Greeley, Rooks, Decatur, Meade, Rawlins, Cheyenne, Wallace, Stanton, Rush,

Graham, Douglas, Gray, Pawnee, Crawford, Montgomery Counties.

Hesperotettix speciosus. Scudder.

Grass green to a darker brownish green; head often flecked with fuscous or dark olivaceous; antennae pale pink to ferruginous becoming testaceous at the tip in some of the specimens; the first two basal joints grass green or olivaceous often as long or longer than than the head and pronotum together. Most of the specimens have the median carina of the pronotum pink rosette, in some specimens it is more pallid; tegmina vary from pale green and yellowish green to yellowish brown in the darker forms, the longitudinal veins yellow to yellowish green. Hind tibia light green becoming yellowish green toward the tip; furcula consist of small lobes little longer than broad, sometimes triangular. Subapical tubercle often transverse.

Measurements.

Length of body,	male	23 - 24.5 m.m.
	female	27 - 36 m.m.
Tegmina	male	11.5 - 13 m.m.
	female	14 - 20 m.m.
Antennae	male	10 - 10.5 m.m.
	female	8.5 - 11 m.m.

Hind femora	male	13 - 15 m.m.
	female	14.5 - 19.5 m.m.

This species is very common and has been collected in all parts of the state where collections have been made.

Hesperotettix pratensis. Scudder.

Head yellowish green, flecked with fuscous in front, lower portion of face more or less purplish to dark green; a blackish or fuscous stripe on vertex of head usually extending back over the entire pronotum, a lighter colored median stripe is sometimes present. Pronotum of both male and female increasing slightly from the front backward. All specimens have a pallid line along the position of the lateral carina of the prozona, extending in some cases across the head and following the upper hinder margin of the eyes to the vertex, in a few specimens the pallid line also extends backward across the metazona. The white dashes on the lateral aspect of the pronotum usually fade out entirely upon drying. Tegmina rarely as short as the length of the abdomen in length from 2 to 4 m.m.; the anal vein is usually

marked by a distinct pinkish stripe, varying more or less in width. Male cerci straight to feebly downcurved.

Measurements.

Length of body,	male	20-22 m.m.
	female	18-31 m.m.
Tegmina	male	16-18 m.m.
	female	14-22.5 m.m.
Antennae	male	8.5 m.m.
	female	7 - 9 m.m.
Hind femora	male	11.5 - 12 m.m.
	female	13.5 - 16.5 m.m.

Locality, Counties,

Ford, Sedgwick, Gray, Douglas, Seward, Sherman, Logan, Stevens, Norton.

This species is much more rare than H. speciosus.

Aeoloplus. Scudder.

Body relatively short and stout, considerably enlarged at the metathorax, even in the male. Head normal, the eyes moderately distant, not very prominent except sometimes in the male, the summit well arched, the fastigium slightly sulcate between the eyes, the frontal costa moderately broad, subequal, plane or nearly plant; antennae moderately stout, cylindrical,

equal, slightly longer (male) or slightly shorter (female) than the head and pronotum together. Pronotum stout, regularly increasing in size from in front backward, the disk gently convex transversely, the prozona slightly and independently tumid, with no or an exceedingly feeble median carina, distinguishing it from the flat carinulate metazona; posterior margin of pronotum very obtusely angulate, the angle more or less rounded; prozona about half again as long as the metzaona, generally slightly broader than long or quadrate. Prosternal spine conical, erect; interval between mesosternal lobes of male about twice as long as broad, often clepsydral from the convexity of the inner margins of the lobes, of female varying from the same to quadrate, the metasternal lobes attingent or subattingent in this male, a little distant in the female. Fore and middle femora considerably tumid in the male, the hind femora relatively short and stout, occasionally furnished inferiorly in the male with a basal tooth protecting the calcaria when the tibia are closed upon the femora. Tegmina generally completely developed, but often somewhat abbreviate, rarely

lobate. Subgenital plate of male with the lateral margins very strongly ampliate and arched at the base, and furnished with a distinct but not very prominent subapical tubercle, the apical margin of the plate forming its inner base; furcula scarcely or not apparent; cerci tapering, apically very slender, simple; terminal segments of female abdomen more or less considerably abbreviated, the ovipositor only partially exerted.

This genus is closely related to Hesperotettix, and these two genera are the only ones in the section of Melanopli with ampliate base to the lateral margins of the subgenital plate, in which the abdomen terminates in a tubercle distinct from the margin itself, though it is a rather common feature in the alternate section;

S. C. Scudder.

Key to the species of Aeoloplus.

A^1. Tegmina at rest extending slightly to considerably beyond the tip or the abdomen, especially in the male. Supraanal plate of male subtriangular with broadly angulate sides, cerci more than twice as

broad at base than at tip.

regalis.

A^2. Tegmina at rest shorter, as long as, or slightly longer than the tip of the abdomen. Supraanal plate of male triangular, sides nearly straight, cerci at the base scarcely more than twice as broad as at tip.

turnbulli.*

Aeoloplus regalis.

The variation among the specimens before us is very slight, being limited to shades of coloration, and the markings of the hind femora. They conform with Scudders description. The range of coloration is noticeable, the green varying from light to dark green. The ground color varies from testaceous to greenish yellow. Of the femur Scudder says "testaceous yellow with two broad angulate and sagettate bands darkest above"; our specimens present these features and in addition a basal spot which sometimes takes the form of a third oblique stripe. In some these angular bands fuse so as to cover almost the entire surface of the femur. The pallid base of the hind tibia mentioned by Scudder takes in our

*Reported from Kansas by Brüner.

specimens the form of a clearly defined annulus.

L.C. Hunter & Sutton

Measurements.

Length of body,	male	18 - 24 m.m.
	female	22 - 28 m.m.
Tegmina	male	14 - 20 m.m.
	female	17 - 19.5 m.m.
Antennae	male	8 - 11 m.m.
	female	9 - 10 m.m.
Hind femora	male	11 - 14 m.m.
	female	15 - 16.5 m.m.

Found everywhere over the state, and is one of the first to mature in spring. There probably are two generations a year.

Melanoplus. Stal.

Body moderately stout, rarely slender, generally feebly compressed, more or less but generally feebly pilose. Head moderately, rarely not at all, prominent, generally but little if any longer than the prozona, unless the latter (as rarely) is distinctly transverse; face almost vertical or a little oblique, its angle with the fastigium rarely less than 75 degrees; vertex gently tumid; eyes rounded oval, never more generally less than half as long again as broad,

the anterior margin subtruncate or feebly convex, separated above rather or narrowly, at most but little farther apart than the width of the equal or subequal frontal costa; fastigium more or less sometimes very declivent, passing insensibly into the frontal costa, always more or less sulcate or with elevated lateral margins generally more deeply sulcate in the male than in the female; frontal costa moderately prominent, generally sulcate below, usually more or less punctate; antennae slender of variable length, but never very short, never longer than the hind femora, and rarely if ever more than twice as long as the pronotum, even when this is subtruncate posteriorly. Pronotum generally subcompressed, rarely or never twice as long as the average breadth, generally only half again as long as the average breadth even in the male, the metazona generally more or less flaring, its disk plane and densely punctate, while that of the prozona is more or less, generally slightly, convex, is rarely at all flaring in front or only in the very slightest degree, at most faintly punctate and generally distinctly longer than the metazona; front margin generally

truncate or subtruncate, hind margin obtuseangulate to a greater or less degree, rarely subtruncate; median carina always distinct on the metazona, generally much less so on the prozona, often subobsolete between the sulci and never wholly wanting; lateral carina typically obsolete, but often indicated by a distinctly abrupt though rounded shoulder, rarely becoming carinate; lateral lobes vertical or subvertical, especially below, often feebly tumid above on the prozona, and generally marked by a piceous postocular band, crossing either the prozona alone or the whole pronotum, not infrequently broken or maculate. Prosternal spine variable, but always prominent; meso- and metastethia together distinctly longer than broad in both sexes, interspace between mesosternal lobes generally longer or much longer than broad, never in the least broader than long, even when the sides of the interspace are very divergent posteriorly (male) or generally quadrate but more variable than in the other sex, sometimes as narrow as there but more frequently subtransverse, occasionally in brachypterous forms distinctly transverse, as a general rule wider in the

in the other sex (female), in both always distinctly, generally much, narrower than the lobes themselves, metasternal lobes generally attingent or subattingent, rarely only approximate (male), or generally approximate or subapproximate, the interspace between them generally narrower than the frontal costa (female); metasternum rapidly narrowing posteriorly, so that the portion behind the lobes is not, or is hardly more than, half the greatest width of the metasternum, but is more than twice as broad as long. Tegmina always present, but either abbreviate and then lateral, attingent, or overlapping, sometimes shorter and sometimes longer than, but generally nearly the length of the pronotum, and usually more or less acuminate apically; or they are fully developed and then usually about attain or a little surpass the tips of the hind femora, tapering more or less but very gradually and apically well rounded, at a distance from the apex equal to the breadth of the tegmina distinctly narrower than the metazona, the intercalaries and cross-veins of the discoidal area relatively numerous at least in the apical fourth and usually throughout, the venation in

general sharp and clearly defined, the humeral vein straight and only apically arcuate, nearly always terminating either on the apical margin or only a short distance before it, running for some distance almost exactly parallel to the costal margin or merging insensibly into it, the area intercalata always, even in macropterous forms of dimorphic species, extending somewhat, generally considerably, beyond the middle of the tegmina. Hind femora moderately long and slender, the inferior genicular lobe with at least a darker basal spot or transverse band, the hind tibia with a variable number of spines (generally 9 to 14) in the outer series, by rare exception eight only. Abdomen more or less compressed, the sides of the first segment with a distinct tympanum, the extremity of the male more or less sometimes strongly clavate, usually considerably recurved, the subgenital plate of variable form, but always with the lateral margins ampliate at the base and with no distinct apical tubercle, though not infrequently apically produced or subtuberculate and frequently tumescent; cerci exceedingly variable in form, often enlarging apically, always lamellate excepting (the

lakinus series) where they are basally globose, never styliform, rarely in the least substyleform, generally incurved and of about the length of the supraanal plate; furcula usually developed and to a very variable extent, and with variable form; pallium rarely exerted; ovipositor of female generally fully exerted.

S.G.Sucdder.

Key to the Melanopli.

A^1. Tegmina conspicuously shorter than the abdomen, often no longer than pronotum; furcula generally feebly developed, generally no longer than the last dorsal segment from which it arises.

b^1. Cerci of male expanding from the base outward and bullate, abruptly tapering and bent inward at the tip; subgenital plate of male abruptly elevated apically.

c^1. Interval between mesosternal lobes of male distinctly twice as long as broad; of female fully half as broad as long.

marculentus.

c^2. Interval between mesosternal lobes of male distinctly less than twice as long as broad; of female barely broader or not broader than

long. lakinus.

b^2. Cerci of male tapering in the basal half, usually from the very base, sometimes thruout, usually laminate; subgenital plate of male of variable elevation apically.

c^1. Cerci of male beyond the middle either equal or tapering, sometimes simply styliform thruout, the tip usually more or less pointed, metasternal lobes of male attingent or subattingent.

d^1. Cerci of male very broad and short, not more than twice as long as the middle breadth, and broadly rounded at apex. discolor.

d^2. Cerci of male more elongate, at least twice generally much more than twice, as long as middle breadth, ordinarily more or less acuminate at apex. scudderi.

c^2. Cerci of male more or less expanded apically so as to be broader at some point beyond the middle, than at the middle, spatulate or subspatulate.

d^1. Subgenital plate of male short and broad,

its apical breadth equal to or surpassing the length of its lateral margin.

texanus.*

d^2. Subgenital plate of male distinctly narrower than long, often narrowing apically.

gracilis.**

A^2. Tegmina nearly or quite as long as, or longer than the abdomen; furcula generally well developed, generally at least a quarter as long as the supraanal plate, but sometimes obsolete.

b^1. Cerci of male expanding from the base toward the middle, as a whole broad and short, flabellate, not expanded apically.

c^1. Cerci of male twice as broad in broadest as in narrowest portion.

d^1. Subgenital plate of male with a distinct though minute independent apical tubercle.

occidentalis.

d^2. Subgenital plate of male with no trace of an apical tubercle.

regalis.

*Reported from Labette Co., Kans., by Scudder, Proceedings of Natl. Museum, Vol. 20.
**Reported from Sedgwick Co., Kans., by Isely, Kansas Academy of Science, Vol. XIX. '03 & '04.

o^2. Cerci of male with no striking inequality in breadth.

flabellifer

b^2. Cerci of male tapering from the very base toward the middle, rarely equal in basal portion; generally long and slender and rarely as little as twice as long as broad.

c^1. Cerci of male beyond the middle either equal or tapering, the tip usually slender or acuminate, never bifurcate.

d^1. Furcula of male developed as large flattened lobes, about half as long as the supraanal plate and exceptionally broad, but apically narrowed by the considerable escision of the inner side; subgenital plate not elevated apically above the lateral margins.

e^1. Forks of the male furcula more or less obliquily or transversely truncate at tip, and given an oppositely hooked appearance by the rounded excision of the inner margin; hind femora generally distinctly banded.

f^1. Lateral lobes of prozona with a broad

and usually distinct piceous band above; tegmina generally distinctly flecked along the middle line.

bowditchi.

f^2. Lateral lobes of prozona with a narrow or no distinct band above; tegmina very obscurely flecked, it at all, along the middle line.

flavidus.

e^2. Forks of the male furcula rounded symmetrically at the tip, the inner margin scarcely more excised than the outer, so that the forks are straight and not oppositely hooked; band of hind femora scarcely perceptible.

elongatus.

d^2. Furcula of male variously developed, rarely at all unusually broad and flattened, and then either not apically emarginate on the inner side, or the subgenital plate is considerably elevated apically, or both.

e^1. Subgenital plate of male almost or quite as broad as the marginal length, its apical margin generally notched; cerci broad and nearly equally broad thruout (except sometimes narrowed by the obliqui excision on the lower side of

the apical half), the basal half scarcely tapering, the whole rarely more than twice and never thrice as long as the middle breadth (except in a few cases, and then the apical margin of the subgenital plate is mesially notched) very broadly rounded at the apex.

f^1. Apical margin of subgenital plate of male not mesially notched; mesosternum of male variable.

g^1. Apical margin of subgenital plate of male but slightly elevated above the lateral margin and moderately prolonged posteriorly; mesosternum of male in front of lobes flat.

glaucipes.

g^2. Apical margin of subgenital plate of male conspicuously elevated above the lateral margin and greatly prolonged posteriorly; mesosternum of male in front of lobes with a central swelling forming a blunt tubercle.

scitus.

f^2. Apical margin of subgenital plate of male mesially notched; mesosternum of male in

front of lobes with a central swelling forming a blunt tubercle.

g^1. Tegmina extending beyond hind femora if at all, by not more than the length of the pronotum, prozona of male quadrate or very feebly transverse; cerci of male generally almost or quite twice as long as broad.

atlanis.

g^2. Tegmina extending beyond hind femora by the length of the pronotum or nearly as much, often by the length of the head and pronotum combined; prozona of male generally strongly transverse; cerci of male not more than half as long again as broad.

spretus.*

e^2. Subgenital plate of male entire, narrower than long, apically conspicuously narrower than at base, cerci distinctly narrowing on basal half, the upper angle of the apex prolonged and often subacuminate.

f^1. Pronotum marked above with light carinal streaks on dark background; tegmina dark olivaceous green.

plumbeus.

* Now apparently extinct

f^2. Pronotum uniform in coloring above; tegmina dark fuscous.

femur-rubrum.

c^2. Cerci of male more or less expanded apically, so as to be broader at some point beyond the middle than at the middle, spatulate or subspatulate or apically befurcate.

d^1. Cerci of male spatulate or subspatulate, at most moderately broad, apically entire and no broader than at base; furcula always developed as distinct denticulations, generally as long or very long ones.

e^1. Furcula of male long and prominent, the projecting portion much longer than the last dorsal segment from which it springs, generally more than a third as long as the supraanal plate.

f^1. Subgenital plate of male not very broad at apex, distinctly narrower than long, not notched, furcula about half as long as supraanal plate.

bispinosus.

f^2. Subgenital plate of male very broad apically, nearly or quite as long as

broad, apically generally notched, though feebly; furcula rarely more than a third the length of subgenital plate.

g^1. Hind tibia red.

coccineipes.

g^2. Hind tibia glaucous.

h^1. Furcula of male not more than a third as long as supraanal plate; tegmina lightly or not at all maculate.

angustipennis.

h^2. Furcula of male more than a third as long as supraanal plate; tegmina usually heavily maculate.

impiger.

e^2. Furcula of male slight, the projecting portion not longer or scarcely longer than the last dorsal segment from which it springs.

f^1. Interval between mesosternal lobes of male nearly or quite twice as long as broad.

g^1. Median carina of pronotum obsolete or almost obsolete on the prozona, distinct but low on the metazona; extremity of male cerci nearly plain exteriorly or merely depressed within the margin; fork of

furcula conspicuously divergent.

h^1. Prozona ordinarily with a broad median dark stripe, made more conspicuous by the much lighter colors on either side, or else light brownish testaceous; antennae of male little more than three-fourths as long as hind femora; hind tibia blue or red. packardii.

h^2. Prozona with uniform dingy coloring on disk; antennae of male almost as long as hind femora; hind tibia red. foedus.

g^2. Median carina of pronotum tolerably distinct on the prozona, at least anteriorly, distinct and moderately high on the metazona; extremity of male cerci deeply sulcate exteriorly or else tumid; forks of furcula parallel or only slightly divergent. conspersus.

f^2. Interval between the mesosternal lobes of male subquadrate. compactus.

d^2. Cerci of male apically bifurcate, or with an inferior submedian process or abrupt angulation, or else expanded so as to be distinctly, generally much, broader apically than at extreme base, furcula wanting or minute.

e^1. Size small or medium; supraanal plate of male pretty regularly triangular, with straight or feebly convex lateral margins; furcula usually distinctly developed; prosternal spine usually short.

f^1. Furcula of male consisting of slender spines, longer than the last dorsal segment; base of lateral margins of subgenital plate incurved.

minor.

f^2. Furcula of male consisting of brief triangular lobes; base of lateral margins of subgenital plate incurved.

luridus.

e^2. Size large; supranal plate of male of variable shape; furcula either absent or very minutely developed; prosternal spine usually long.

f^1. Furcula of male entirely absent or present only as a minute point or bead; hind tibia

usually yellow.

differentialis.

f^2. Furcula of male distinctly present, though always very small, angulate, the angle rarely produced; hind tibia never entirely yellow.

bivittatus.

Melanoplus marculentus. Brunner.

Of this genus we have no representative in the collection now but it has been reported from Kansas by Hunter and Sutton in Psyche, July, 1900. The following notes are taken from their report. This specimen of marculentus manifests a trait liable to appear in short-winged varieties. It agrees with Scudder's description with the exception of the darker coloring of the upper portion of the head and pronotum, and the greater length of the subgenital plate, but instead of the normal abbreviate wing the insect has well developed tegmina and wings. The tegmina extend clearly beyond the end of the abdomen and are remarkably broad for one of this genus. Width of tegmina 6 m.m., length 11 m.m. (tips were frayed) Basal half testaceous, two or three testaceous spots on the discoidal area. Wings hyaline, veins and crossveins fuscous in distal

portion, glaucous basally.

Russel County.

Melanoplus lakinus. Scudd.

Antennae a little more (male) or a little less (female) than two-thirds the length of the hind femora. Frontal costa variably sulcate. Median carina more distinct on metazona than on prozona. Prozona of female longer than metazona. Lateral carina more or less distinctly marked, forming rather square shoulders. Furcula with the pointed projections subparallel, widely separated and extending outside of the ridge of the median sulcus of the supraanal plate.

The general color is brownish griseous tinged with olivaceous, and yellowish beneath. Antennae apically infuscated. The bands on the head and pronotum vary from piceous black to dark olivaceous. Hind femora trifaciate above with dark olivaceous.

Measurements.

Length of body,	male	17-23 m.m.
	female	23-32 m.m.
Tegmina	male	4.5-16.5 m.m.
	female	6-20 m.m.
Antennae	male	7.5-9 m.m.

	female	8.5-10 j.m.
Hind femora	male	9.5-13.5 m.m.
	female	12.5-17.5 m.m.

This species is very common in Kansas and is one of the first to mature in spring. Fully developed specimens have been found the first of June. There very probably are two generations a year. Although very common and at times quite numerous we have never observed them in large enough numbers to be of any great economic importance. They are found along the roadsides and pastures as well as in cultivated fields. The length of the tegmina varies from very short to ones that extend the entire length of the abdomen or even beyond it. We have observed the females oviposit from the middle of June till late in Setpember and even in October.

Found in all Counties where collecting has been done.

Melanoplus discolor. Scudd.

The general color is brownish fuscous above and yellowish brown below. Antennae ferruginous, somewhat infuscated at the tip. A very broad piceous belt which widens posteriorly, extends from behind the eyes across the prozona. Tegmina are darker on the lateral field

than on the dorsal.

Vertex of head consideraly elevated above the pronotum of the male, but not elevated at all in the female. Frontal costa subequal, flat above ocellus, slightly sulcate at and below ocellus. Median carina distinct, cut only by the principal sulcus. Prosternal spine cylindrical, blunt and retrorse. Supraanal plate of male triangular, with median sulcus extending half the length of the plate. Furcula very small approximate lobes, the lobes shorter than the last dorsal segment from which it springs. Hind femora trifasciate above with blackish, the basal fasciation taking the form of a dark spot. Hind tibia bright red with blacktipped spines 11 to 12 in number in the outer series.

Measurements.

Length of body,	male	16-18.5 m.m.
	female	22 m.m.
Tegmina	male	6-9 m.m.
	female	10 m.m.
Antennae	male	7-8.5 m.m.
	female	8 m.m.
Hind femora	male	9-11.5 m.m.
	female	12.5 m.m.

Clark, Osborne, and Grant Counties.

Now. first reported from Kansas.

Melanoplus scudderi. Uhler.

The postocular band varies from obscure fuscous to piceous black. Frontal costa subequal, about as wide as the interspace between the eyes. Eyes somewhat longer than the infraocular portion of the genae, but not "much longer". Infuscation of apical portion of antennae slight. Tegmina in the male not much longer than prozona, of female about as long as pronotum. The hind femora of all specimens have a distinct olivaceous tinge on the outer face, and most of them on the lower, bifasciate above. Hind tibia with 11 to 13 spines in the outer series. Cerci of male less than twice as long as the basal breadth, and not more than one half again as long, very slightly sulcate in the apical half. Subgenital plate of male slightly raised apically.

Measurements.

Length of body,	male	18 m.m.
	female	22.5 m.m.
Tegmina	male	3.25 m.m.

	female	6.5 m.m.
Antennae	male	8.5 m.m.
	female	9 m.m.
Hind femora	male	10.5 m.m.
	female	14 m.m.

Locality, Counties.

Douglas, Sedgwick, Riley.

Melanoplus occidentalis. Thomas.

Interspace between the eys of male as wide or a little wider than the first antennal joint. Median carina more distinct on the metazona than on the prozona but distinctly present between the sulci. Tegmina extending beyond the tip of the abdomen in all specimens by 1.5 m.m. or more. The blackish brown median stripe passing from between the eys backwards extends in most specimens back over the entire prozona. A piceous postocular band continues backward, more or less broken, over the prozona, expanding posteriorly. Hind femora trifasciate above with fuscous. Hind tibia with ten blacktipped spines in the outer series.

Measurements.

Length of body, male 18-22 m.m.

female 28 m.m.

Tegmina	male	16-17.5 m.m.
	female	20.5 m.m.
Antennae	male	8.5-9.5 m.m.
	female	10 m.m.
Hind femora	male	12-12.5 m.m.
	female	15 m.m.

Hamilton, Morton, Greeley, Stanton, Gove, Rawlins, Grant, Stevens.

Malanoplus regalis. Dodge.

This handsome species is singularly like Aeoloplus regalis in appearance, nearly equalling it in size, closely resembling it in color and general form, but at once distinguished from it by the non-tuberculate subgenital plate of the male, the dullpointed valves of the ovipositer of the female, and the cherry red coloring of the lower sulcus and inner face of the hind femora. l.c. A.P.Morse.

Fastigium shallowly sulcate; frontal costa subequal, depressed at the ocellus. Median carina more distinct on the metazona than on the prozona; tegmina brownish flecked with dark brown. A black postocular band extends to the thorax and across the prozona as

a more or less distinct brownish stripe. Hind femora reddish brown on the outer face, inner and lower side bright red, bifasciate above with olivaceous; hind tibia blue, spines blue with black tips 9 to 10 in number in the outer series. Antennae testaceous.

Measurements.

Length of body,	male	21-26.5 m.m.
	female	27.5 - 31 m.m.
Tegmina	male	15-17.5 m.m.
	female	19-20.5 m.m.
Antennae	male	8.5-9 m.m. (approx.)
	female	10 m.m.
Hind femora	male	11-13 m.m.
	female	14-14.5 m.m.

Localities.

Morton, Grant, and Stevens Counties.

Melanoplus bowditchi. Scudder.

The general color is griseous or grayish brown. Disk of pronotum is marked in longitudinal stripes with a darker stripe in the middle and two lighter stripes on the side near the position of the lateral carina. The head and sides of pronotum are more or less mottled with olivaceous and ferruginous. The

species looks quite a little like M.pictus. The tibia are very hairy. Top of hind femora transversely marked with fuscous, approaching trifasciation, interspace between the eyes of male a little wider than the first antennal joint. Frontal costa subequal, reaching the clypeus, biseriately punctate above the ocellus. Tegmina of male extending beyond the tips of the hind femora in several cases by 3 m.m. Furcula much larger than the cerci, attingent in the basal half and then separating at an angle of about 35 to 40 degrees.

Measurements.

Length of body,	male	22-26 m.m.
Tegmina	male	18-21 m.m.
Antennae	male	10-12 m.m.
Hind femora	male	11.5-14 m.m.

Localities.

Greeley, Meade, and Seward Counties.

Melanoplus flavidus. Scudder.

General color brownish fuscous with a slight greenish tinge especially along the tegmina. Antennae yellowish with slight testaceous at the tip. A dark-brown almost black band extends backward from behind

the eye across the pronotum widening posteriorly, the color of this stripe is not uniform but mottled more or less with light brown. The tegmina have the general color of the insect except that the distal half has a more or less distinct bluish tinge, being almost entirely free from any maculation. Prozona of male slightly longer than metazona. Front margin of pronotum truncate with a slight emargination, hind margin obtuseangulate, the angle well rounded.

Measurements,

Length of body	male 24-28 m.m.
Tegmina	male 17-24 m.m.
Antennae	male 10.5 - 13 m.m.
Hind femora	male 11.5 - 15 m.m.

Localities.

Stanton, Seward, Meade, Stevens, Morton, and Graham Counties.

Melanoplus elangatus. Scudder.

This species is very closely related to M. flavidus and ~~more~~ M. bowditchi but is generally somewhat larger, more slender and more lively colored. It is about the same size of M. packardii. Median carina

distinct on metazona but indistinct on the prozona; sulci of pronotum not cutting the median carina. Front margin of pronotum truncate with a slight emargination. The tegmina are long and slender, feebly or not at all flecked. In the other details the specimens agree very closely with Scudder's description.

Measurements.

Length of body	male	25-31 m.m.
	female	27-33 m.m.
Tegmina	male	21-28 m.m.
	female	22-30 m.m.
Antennae	Male	11-15 m.m.(Approx.)
	female	9.5 m.m.
Hind femora	male	13.5-16.5 m.m.
	female	15-18 m.m.

Localities.

Trego, Morton, Hamilton, and Finney Counties. This species has never been found to appear in large enough numbers to be of any economic importance.

Melanoplus glaucipes. Scudder.

General color fuscous to fusco-testaceous. A black piceous band extends back from the eye over the entire pronotum, widening posteriorly and extending

downward in two lines over the pleura of the meso- and metathorax. In one male the tegmina are as long as the abdomen, in the other specimens the tegmina are quite a little shorter than the abdomen. The subgenital plate of male is slightly elevated apically, the apex rather square than uniformly rounded.

Measurements.

Length of body	male	22-24 m.m.
	female	27-28 m.m.
Tegmina	male	13.5-15 m.m.
	female	15.5-16 m.m.
Antennae	male	9.5 m.m. (approx.)
	female	10 m.m. "
Hind femora	male	11.5-12.5 m.m.
	female	13-14 m.m.

Localities,

Rooks, Russel, and Finney Counties.

Melanoplus scitus. Scudder.

General color luteo-testaceous to brownish fuscous, marked with fuscous. Head plumbeo-fusceus in the darker forms and yellow to fuscesent in the lighter forms. Vertex with a dark mesial band expanding posteriorly. A piceous band extending from behind the eyes across the side of the pronotum. Vertex

of head raised distinctly above the level of the pronotum. Sulcus of fastigium not very shallow; frontal costa failing to reach the clypeus. Antennae ferrugino-testaceous to ferruginous, about three fourths as long as the hind femora. Front margin of pronotum transverse, slightly emarginate; median carina on metazona distinct, on prozona subobsolete, sides of metazona shouldered. Disk of prozona feebly punctate, of metazona densely punctate. Tegmina surpassing the hind femora by from 2 to 3.5 m.m. Furoula reaching a little beyond one-third the length of the supraanal plate, the apical half of the furcula densely punctate; cerci subequal, little more than twice as long as broad, slightly sulcate and emarginate below, Supraanal plate of male finely punctate all over.

Measurements.

Length of body	male	22-26 m.m.
Tegmina	male	18.5-22 m.m.
Antennae	male	9-10 m.m.
Hind femora	male	13-14 m.m.

Localities.

Greeley, Wichita, Stevens, Scott, Morton, Stanton, Clark, Rawlins, Riley, and Hamilton Counties.

Now first reported from Kansas.

Melanoplus atlanis. Riley.

"Genae and sides of pronotum varying from yellowish testaceous to dark griseo-fuscous. Markings of vertex of pronotum variable, vertex generally showing a dark mottled stripe widening posteriorly and a lighter linear area between this and the eye. Sometimes the vertex is marked with irregular diffusion offuscous. Dorsum of pronotum dark griseofuscous, sometimes uniform and noticeably darker along the median line, or rarely lighter in this position."

This species is very closely related to M. spretus Uhl. the famous Rocky Mountain Locust. It is sometimes spoken of as the lesser migratory locust and is known to fly for considerable distances. In size and color it is also very closely related to M. femur-rubrum the common red-legged 'hopper, but may be readily distinguished by the notch in the apical portion of the subgenital plate and the blunt tubercle or swelling on the mesosternum in front of the lobes. This species becomes so numer-

our at times as to be of real economic importance. The habits of this species and the method of control are very similar to some of the other species and will be discussed later.

M. atlanis may be found all over the state, and is found in all kinds of vegetation, cultivated as well as uncultivated fields. The writer has noticed females of this species oviposit as late as November 15.

Measurements.

Length of body,	male	20-26 m.m.
	female	22-28 m.m.
Tegmina	male	18-24 m.m.
	female	18-25 m.m.
Antennae	male	9.5-11 m.m.
	female	9-10 m.m.
Hind femora	male	12-15 m.m.
	female	12-15 m.m.

Melanoplus spretus. Uhler.

In general appearance this species is very much like M. atlanis. This is the famous and dreaded Rocky Mountain locust which invaded Kansas in the early days and caused the complete destruction of all growing vegetation. It is the true migratory grass-

hopper and has been known to fly great distances. Although once very much dreaded it has now apparently become extinot. During the Grasshopper campaign in the western part of the state in 1913 no specimens of this species were noticed. Its place seems to have been taken by M. atlanis which occurs all over the state but seldom becomes very numerous; even in the summer of 1913 although there were a good many specimens of this species present they were not as numerous as M. differentialis and M. bivitattus.

Many people believe that our native large yellow grasshoppers M. differentialis and M. bivitattus are migratory and fly great distances. This erroneous belief is based partly upon the reports given out by the old settlers of their experiences with the grasshoppers in the seventies, but chiefly upon newspaper reports. Whenever there is a small outbreak of 'hoppers the newspaper reporters go back to their old files and find an exciting article about the RockyMountain locust and by adding a few more of their own ideas they are able to present to the public quite an "interesting"

article. The article is usually accompanied by some misleading illustration and the people are lead to believe that the grasshoppers on their premises have come from a far away place and if killed or poisoned will be followed by another horde the next day.

Melanoplus plumbeus. Dodge.

"Of medium size, very dark fusoo-olivaceous, with bright luteus or flavous markings". Prozona of male sometimes a little longer than the metazona; prosternal spine retrorse or appressed in both male and female. Interspace between mesosternal lobes of female subquadrate. Fore and middle femora of male more or less tumid; hind femora trifasciate above with blackish olivaceous. Apical portion of malo cerci fully half as wide as at the base.

Measurements.

Length of body	male	20-24.5	m.m.
	female	24-26	m.m.
Tegmina	male	18-19	m.m.
	female	21	m.m.
Antennae	male	9	m.m. (approx.)

	female	7.5 m.m. (approx.)
Hind femora	male	12-12.5
	female	13.5-14 m.m.

Localities.

Logan, Cheyenne, Wallace, Rawlins, Morton, Grant, Thomas, Decatur, Counties.

Melanoplus femur-rubrum. DeGeer.

This species is commonly known as the redlegged grasshopper or locust and is common everywhere. The general ground color is brownish-fuscous, often with a yellowish or olivaceous tinge. The head and pronotum are mottled with fuscous and olivaceous; a piceous postocular band extends beyond the prozona and widens posteriorly. Front margin of prozona slightly emarginate; the transverse sulci of prozona not cutting the median carina. Tegmina surpassing the hind femora by various lengths. (A specimen from Colorado in our collection has tegmina not much over half the length of the abdomen; the specimen is only about half as large as the ordinary specimens found here.) None of these specimens with abbreviate tegmina have been found in Kansas so far. The tegmina are more or

less maculate; upper face of hind femora trifasciate; hind tibia red or pale blue though more often red.

Measurements.

Length of body	male	22-26 m.m.
	female	23-27 m.m.
Tegmina	male	19-22 m.m.
	female	19.5-22.5 m.m.
Antennae	male	9.5-11 m.m.
	female	8.5-9.5 m.m.
Hind femora	male	12-13.5 m.m.
	female	14-15.5 m.m.

Localities, Found everywhere over the entire state.

As stated under M. atlanis this species compares pretty well in size and color with atlanis and the two may easily be interchanged unless a close examination is made, as they both are very common and at times become numerous to be of real economic importance. Writers on Orthoptera have reported this species as inhabiting mostly lowlands, but our collections from the extreme western part of the state shows that this species was just as numerous on the plains as any of the other species. In the summer of 1913 femur-rubrum was quite numerous in western Kansas and did considerable damage, especially to the alfalfa fields.

Melanoplus bispinosus. Scudder.

Cinerio-fuscous, very slightly ferrugihous. Tegmina surpassing the hind femora by from 2 to 3 m.m.; hind tibia dull green to brighter green, spines 1- to 12 in number in the outer series. EXtremity of male abdomen slightly clavate, very little upturned; the furcula diverge slightly. In the other characters the specimens at hand correspond very well with those given by Scudder.

Measurements.

Length of body	male	23.5-26.5 m.m.
Tegmina	male	19-22 m.m.
Antennae	male	10-12 m.m. (approx.)
Hind femora	male	12.5-14.5 m.m.

Localities.

Haskell, Pratt, and Osborne Counties.

Melanoplus cocoineipes Scudder.

Of dark fuscous color, head and thorax with a ferrugino-testaceous tinge; frontal costa widening anteriorly, sulcate at and below the ocellus; antennae ferrugino-testaceous. Interspace between mesosternal lobes of male not more than three times as long as wide;

tegmina surpassing the tips of the hind femora by 3.25 m.m. Furcula of male about two-fifths the length of the supraanal plate.

Measurements.

Length of body	male	23 m.m.
Tegmina	male	20.5 m.m.
Antennae	male	11 m.m. (approx.)
Hind femora	male	14 m.m.

One male specimen, Gray County.

Melanoplus angustipennis Scudder.

The general ground color varies but little in the specimens at hand. The head is quite prominent, postocular piceous band present in most of the specimens; vertex distinctly elevated above the pronotum. Interspace between the eyes of male about twice as wide as the first antennal joint; frontal costa widening anteriorly, just failing to reach the clypeus. A subluteous streak borders the postocular piceous band very distinctly in some specimens but is subobsolete in others. Tegmina surpassing the hind femora about 2 m.m. Hind tibia glaucous or red, spines apically black, 10-11 in number in the outer series. Furcula of male a little more than a third as long as the supraanal plate.

Measurements.

Length of body	male	22-25 m.m.
Tegmina	male	17-20.5 m.m.
Antennae	male	10-11.5 m.m.
Hind femora	male	12-14 m.m.

Localities.

Stevens, Rook, Graham, and Sedgwick Counties.

Melanoplus impiger. Scudder.

Head quite prominent. Frontal costa subequal, just failing to reach the clypeus; antennae fulvous to ferruginous, infuscated at the tip. Disk of pronotum forming with the lateral lobes a much sharper shoulder on the metazona than on the prozona; front margin of prozona truncate; transverse sulci on disk of prozona deep and percurrent. Tegmina brownish fuscous with very little maculation along the median line; the markings on the hind femora vary from dark fuscous to dark olivaceous. The general color is brownish testaceous with a ferruginous tinge.

Measurements.

Length of body	male	22-27.5 m.m.
Tegmina	male	18-22 m.m.

antennae male 10.5-12 m.m.

Hind femora male 12-16 m.m.

Localities.

Sedgwick, Ford, Stevens and Seward Counties.

Melanoplus packardii. Scudder.

This species varies considerably in the general ground colors, varying from real light yellow to dark brownish fuscous. Medio-dorsal stripe varies both in intensity of color and in breadth; in color from testaceous to blackish, in width from a rather narrow stripe to one half the width of the prozona. In the blue legged forms the stripe often is darker and more clearly defined than in those with red hind tibia and shows a stronger tendency to taper to a point on the metazona. Frontal costa slightly sulcate at and below the ocellus; antennae yellowish brown, infuscated at the tip; tegmina extending beyond the hind femora 2 to 5 m.m. Hind femora bifasciate to trifasciate above; hind tibia blue or red with blacktipped spines 10 to 12 in number in the outer series.

Measurements.

Length of body	male	28-30 m.m.
	female	26-36 m.m.
Tegmina	male	20-25 m.m.
	female	22-28.5 m.m.
Antennae	male	11.5-16 m.m.
	female	9.5-11 m.m.
Hind femora	male	13-17.5 m.m.
	female	15-18.5 m.m.

This species is very common in the state and may be found among practically all the cultivated fields and crops as well as pastures and meadows.

Melanoplus foedus. Scudder.

The general color is "dirty cinereus above and dingy clay-yellow below" Quite similar in size and structure to M. packardii but with red hind tibia. Frontal costa enlarging slightly anteriorly, failing to reach the clypeus. Tegmina extending beyond the abdomen of the male by at least 2 or 3 m.m. Extremity of male abdomen somewhat recurved, clavate. Hind tibia dull red with a blackish basal annulus, spines black 10 to 13 in number in the outer series.

Measurements.

Length of body, male 24.5-30 m.m.

Tegmina male 21.5-23 m.m.

Antennae male 13-14 m.m.

Hind femora male 14.5-15 m.m.

Localities,

Norton and Rooks Counties.

In regard to this species Scudder says: "The species indeed differs but slightly from M. packardii, and may prove to be merely a varietal form of it dependent upon station, which in this species is in the dank vegetaion of river bottoms where M. packardii occurs but rarely". Our specimens in the collection were all taken on the uplands and dry plains.

Melanoplus conspersus. Scudder.

A stout compact medium sized species. The disk of pronotum is dark brown; tegmina heavily maculate, reaching to the tip of the hind femora. The general description agrees with the specimen at hand. Specimens of this species from Colorado are much larger than the specimen from Kansas.

Measurements.

Length of body, male 18 m.m.

Tegmina male 16 m.m.

Antennae male 9 m.m. (approx.)

Hind femora male 11 m.m.

One male from Sherman County.

Melanoplus compactus. Brun. & Scudd.

This species resembles very closely M. conspersus. The general color is brownish fuscous with a ferruginous tinge, especially on the top of the head and disk of pronotum; sulci of pronotum deep and very distinct; median carina cut by the principal sulcus. Tegmina heavily maculate; hind tibia pale blue, more or less valgate with a basal luteus anulus, spines black.

Measurements.

Length of body, female 25-26.5 m.m.

Tegmina female 18.5-20.5 m.m.

Antennae female 9-10 m.m.

Hind femora female 14.14.5 m.m.

Localities.

Four females from Clark County.

Melanoplus minor. Scudder.

Vertex of head slightly elevated above the pronotum; the interspace between the eyes of female about twice as long as the first antennal joint.

Fastigium of male distinctly but not steeply declivent; frontal costa subequal, feebly sulcate, just failing to reach the clypeus. Median carina of pronotum more prominent on metazona than on prozona; prozona of male a little longer than broad, of female subquadrate. Hind femora trifasciate above, the lower face dull to bright orange. Hind tibia glaucus with yellowish at the extremities, spines black tipped usually 11 in number in the outer series. Extremity of male abdomen slightly clavate. The description of the genitalia agrees ~~agrees~~ with Scudder's description.

Measurements.

Length of body,	male	20-21 m.m.
	female	26-27.5 m.m.
Tegmina	male	16-16.5 m.m.
	female	15-19 m.m.
Antennae	male	8-9 m.m.
	female	9.5 m.m. (approx.)
Hind femora	male	12-12.5 m.m.
	female	13-15 m.m.

Localities.

Gove, Russel, and Clark Counties.

Melanoplus luridus. Dodge.

"Rather small in size, brownish fuscous, more or less ferruginous." Interspace between the eyes slightly wider than the first antennal joint. Eyes quite prominent, about as long as the infraocular portion of the genae; prosternal spine somewhat retrorse. Interspace between the mesosternal lobes of male about twice as long as broad. Hind femora bifasciate above with olivaceo-fuscous to blackish fuscous, below luteous, flecked with fuscous and sometimes tinged with orange; hind tibia carmine red. Upper fork of cerci one half to three fifths as wide as the basal piece of the cercus, subequal, apically somewhat expanded, the upper angle considerably more rounded than the lower.

Measurements.

Length of body,	male	21-24.5 m.m.
	female	27-28 m.m.
Tegmina	male	16.5-17.5 m.m.
	female	21-22 m.m.
Antennae	male	8.75-9.5 m.m.
	female	9.5 m.m. (approx.)
Hind femora	male	12.5-14 m.m.
	female	14.5-15.5 m.m.

Localities.

Rooks, Sedgwick, and Riley Counties.

Melanoplus differentialis. Uhler.

This is one of the largest and most common of the species of the Melanopli. It is a heavy rather clumsy insect and together with M. bivittatus is usually referred to by the average person as "the big yellow grasshopper". "The frontal costa is generally equal but rather frequently, slightly expanded at the ocellus. Angle of hind margin of metazona somewhat more obtuse in the male than in the female; the transverse sulci of the pronotum are deeply marked with fuscous on the lateral lobes, and especially at the middle sulcus. In the insects of this species in which the ground color is light or yellowish testaceous there is a strong tendency to marbling of the face and pronotum, with darker testaceous which is frequently localized in three quarters: first, as two diverging stripes upon the vertex, second as irregular clouds upon the face, third as spots principally upon the disk of the pronotum whose outlines follow but do not coincide with those of the blackish fuscous of the sulci". The tegmina extend considerably beyond the tips of the hind femora in many of the female specimens.

Measurements.

Length of body,	male	27-40 m.m.
	female	29-45 m.m.
Tegmina	male	23-35 m.m.
	female	23-38 m.m.
Antennae	male	14-20 m.m.
	female	11-17 m.m.
Hind femora	male	15-20 m.m.
	female	16-23 m.m.

This species is found everywhere in the state and often occurs in large numbers and causes considerable damage.

Melanoplus bivittatus. Say.

The description of this species in Scudder agrees very well with our specimens. Although there occurs quite a little variation in the length of the tegmina, especially in the female, we have never noticed any dimorphism in this line. In size this species agrees well with M. differentialis.

Measurements.

Length of body,	male	22-36 m.m.
	female	32-46 m.m.
Tegmina	male	18-27.5 m.m.
	female	21.5-33 m.m.
Antennae	male	13-18 m.m.

	female	12.5-17 m.m.
Hind femora	male	13.5-18.5 m.m.
	female	17-24 m.m.

This species has been taken in all parts of the state and at times occurs in great numbers, thus causing considerable damage to all kinds of vegetation and even trees. M. bivittatus does not restrict itself to cultivated fields only, but may be found in prairies, meadows, and along the roadside, in fact most anywhere where vegetation occurs. They will defolitate such trees as apple, peach, osage orange, mulberry and many other fruit and shade trees.

Phoetaliotes, Scudder.

Body elongate, rather slender, a little compressed, very feebly pilose, including faintly the tegmina and legs. Head large, full, prominent, relatively elongate nearly half again as long as the prozona, the space behind the eyes fully half as long as the breadth of the eyes, the genae a little tumescent, the head apart from the eyes slightly broader than the pronotum; vertex prominent and well arched both longitudinally and transversely; face a little oblique; eyes rounded

broad oval, moderately prominent, subtruncate anteriorly, moderately distant, somewhat farther apart than the greatest width of the frontal costa; fastigium very faintly sulcate, almost plane; frontal costa prominent, markedly narrower above than below the ocellus; antennae slender, moderately long, but shorter than the hind femora, though fully twice as long as the pronotum. Pronotum of moderate length, faintly subsellate but otherwise equal, feebly flaring in front to receive the head; disk rounded subtectate, with broadly rounded very indistinct lateral carina, and a sharp, equal, and percurrent median carina; prozona longitudinal, nearly half as long again as the metazona, with indistinct transverse sulci; front margin subtruncate, hind margin extremely obtusangulate. Prosternal spine rather large, erect, conical, blunt; meso- and metastethia together much more than twice as long as broad; interspace between mesosternal lobes much (male) or little (female) longer than broad, the metasternal lobes attingent (male) or approximate (female); portion of metasternum behind the lobes about twice as broad as long and about half as broad as the greatest breadth of the metasternum.

tegmina either abbreviate, broad lanceolate, acuminate, attingent, slightly longer than the pronotum, or fully developed, surpassing the hind femora, rather broad and equal, well rounded at tip, hardly tapering in the distal half, at a distance from the apex equal to the breadth of the tegmina as broad as the metazona, the intercalaries and cross, veins of the discoidal area everywhere few, the venation in general, loosem irregular and ill-defined, the humeral vein broadly sinuous, terminating on the costal margin at least as far before the apex as the breadth of the tegmina, nowhere running closely parallel to the costal margin nor gradually merging into it, the area intercalata not reaching the middle of the tegmina. Hind femora long and slender, the genicular lobes pallid with a transverse basal fuscous stripe, the hind tibia glaucous, sometimes yellowish, with 11 to 13 spines in the outer series. Abdomen compressed, mesially carinate, apically clavate and recurved in the male, the subgenital plate narrow and long, with lateral margins ampliate at the base, the apical margin mesially pinched but not elevated, the apical face with no subapical tubercle; furcula delicately

developed; cerci compressed styliform, rather small; ovipositor of female normally exserted.

This genus is very closely related to Melanoplus, from which it is to be distinguished by its large tumid head and subsellate equal pronotum, as well as by its substyliform cerci. The neuration of the tegmina, when the latter are developed, also differs to a certain degree, pointed out in the description.

S.H. Scudder.

Phoetaliotes nebrascensis. Thos.

Varieties nebrascensis and volucris.

Head flavotestaceous to rather ferruginous, especially on the top. The interspace between the eyes of the female is hardly three times as wide as the first antennal joint, in some cases not more than twice as wide. The fastigium is distinctly though not deeply sulcate in most of the specimens; frontal costa nearly reaching the clypeus, about half again as broad below the ocellus than above inthe male, and twice as broad in the female, narrowest just between the antennae. Antennae ferrugino-testaceous, somewhat infuscated at the tip. Disk

or pronotum varies from testaceous to bright ferruginous; median carina sharp, subequal, more distinct on the metazona than on the prozona in some specimens; prozona distinctly longitudinal in the male but subquadrate in the female. Prosternal spine rather retrorse.

Measurements.

		nebrascensis	volucris
Length of body	male	18-22.5 m.m.	22-25 m.m.
	female	22-31 m.m.	26-30 m.m.
Tegmina	male	5-7 m.m.	17-20 m.m.
	female	5.5-8 m.m.	16-21 m.m.
Antennae	male	8-12 m.m.	8.5-10 m.m.
	female	8-10.5 m.m.	8-9.5 m.m.
Hind femora	male	11-13 m.m.	11-12 m.m.
	female	12.5-16 m.m.	13-16 m.m.

Localities.

Sedgwick, Seward, Rooks, Lane, Clark, Osborne, Cheyenne, Graham, Ford, Smith, Scott, Wichita, Stevens, Sherman, Grant, Norton, and Wallace Counties.

Of this species both varieties are quite common and have been found in practically all parts of the state. The short winged variety P. nebrascensis is more common than the long winged variety nebrascensis volucris. Neither one of these varieties have ever been

found in large enough numbers to be of any economic importance.

Freak specimens in species of Melanopli.

In going over a lot of duplicate material, one always finds variations, in one form or other, in specimens of the same species. Usually these variations are slight and not so noticeable in superficial observations, however, once in a while there occur variations or freak specimens which are very readily noticeable, and interesting to study.

Two such freak specimens were found in the collection here in the museum while the writer was working with the Melanopli. The first of these specimens Melanoplus foedus was found to have two distinct median ocelli, both perfect, (each about normal in size) the other two ocelli were present as usual thus giving the grasshopper four perfect ocelli.

B.M. Blackman found a specimen of femur-rubrum with two median ocelli and a description and photographs of the same are given in Psyche. vol 19 pp 92-97

~~Plate~~ Fig 62. shows the head and position of the median ocelli of M. foedus.

The second specimen M. bispinosus shows a great variation in the cerci. The right cersus tapers uniformly from the base toward the tip, is subacuminate and in no way exteriorly sulcate; while the left cersus tapers from the base toward the middle and then enlarges in the apical half so as to be much wider apically than in the middle, sulcate exteriorly so as to be distinctly spatulate.

Figs 63, 64 & 65 ~~Plate~~ shows the dorsal view of the genitalia of this specimen and the right and left lateral views which shows the differences in the shape of the cerci.

PART II

THE BIOLOGIC AND ECONOMIC PHASES OF THE MELANOPLI.

Natural enemies of the Grasshopper.

The grasshoppers have many natural enemies which tend to hold them in check, and without these enemies the farmer would experience much greater losses from the ravages of the grasshoppers, and artificial control measures would have to be employed much oftener. During a season favorable to the development of the grasshopper, they occur in such numbers that their natural enemies are unable to hold them in check, and the 'hoppers become a serious pest. The relation existing between the parasite and its host offers a very interesting problem for study. An increase of the host tends toward a greater increase of the parasite. Sometimes this enemy or parasite, although beneficial in destroying one pest, becomes a pest itself by attacking, at some stage of its life history, some crops; as for instance the blister beetle which in the larval stage is predaceous upon the eggs of the grasshopper, while in the adult stage it does much damage to such crops as potatoes and sugar beets.

Flies.

Several species of parasitic flies often destroy grasshoppers in great numbers. The most important

of these are, Sarcophaga helicis, S. hunteri, S. sarraccniac, and S. kellyi, Bee flies and Tachinid flies are also active in destroying grasshoppers. Some of these flies deposit small maggots upon the bodies of the grasshoppers, the maggots eat their way into the body of the 'hopper, where they feed upon the live insect until they become fullgrown larvae; they then leave the grasshopper which by this time has either been killed or is dying, and go into the ground where they pupate and transform into adult flies. Mr. E.O.G. Kelly of the U.S. Bureau of Entomology has recently discovered one of the above named parasitic flies in Kansas which attacks grasshoppers in great numbers.

The following notes taken from Mr. Kelly's paper shows how effective the work of these parasites is under favorable conditions. "Quite a serious outbreak of grasshoppers occured in the vicinity of Wellston, Okla. early in June 1933, the prevalent species being M. differentialis, M. bivitattus, and M. atlanis, with a few scattering individuals of other species, both imagoes and nymphs doing much damage to corn and alfalfa and literally swarming in grasslands. The grounds were strewn with nymphs and adults of the three species

mentioned which had died from parasitism by sarcophagids, their bodies being alive with maggots, while the fields were also literally swarming with these flies engaged in striking adults and nymphs of each instar, except the first, but deposition took place only while grasshoppers were flying, or in the case of nymphs, hopping. The winged grasshoppers appeared to know that the parasites were after them, as when they took wing they made many twists and turns in attempting to get away from the flies. Several adults of Sarcophaga kellyi were reared from the Wellston material, while later investigations indicated that the grasshoppers had been materially reduced and practically controlled, so that late in September few eggs were to be found."

Mites.

The red grasshopper mite, Trombidium locustarium has probably received too much credit for destroying grasshoppers. According to my observation in the field this mite settles mostly on the tegmina and wings of the grasshopper, seldom on the body of the insect. I have found as many as 50 mites on a single specimen with no noticeable effect except that they

seem to cause the grasshopper considerable discomfort-ure, and in attempting to rid itself of these mites the grasshopper tears his wings and tegmina into shreds by scratching them with his hind tibia. The mite very likely weakens the host to some extent, whether enough to kill it, is rather doubtful.

Beetles.

Beetles and the larvae of beetles are known to be predaceous upon the grasshoppers or their eggs. Of these the blister beetles are probably the most important. Although the blister beetles, in the adult stage, become serious pests to such crops as potatoes and sugar beets, in the larval stage they are very beneficial in destroying many grasshopper eggs. The eggs of the blister beetles are laid in the ground. The newly hatched larvae are very active and at once begin to search for food, which,in several species consists of grasshopper eggs. Whenever one of these eggpods is found the larvae "remain in camp" until the supply is exhausted. In digging up grasshopper eggpods I have found as many as eight larvae of the blister beetle directly under the eggpod. Thus while one pest is suppressed the other is increased and in the beetfields the blisterbeetles are not much to be

preferred to the grasshoppers and can be controlled only by spraying the plants with lead arsenate or Paris green.

Fungus diseases.

There are several fungus diseases which attack grasshoppers and at times kill thousands of them. Most important of these are Empusa grilli and Sporotrichum globuliferum, the latter being the same as the one that attacks chinch bugs. These fungus diseases however, attack the grasshopper only during damp warm weather, and are therefore of little value during a hot dry season.

Birds.

More than a hundred species of birds are known to feed upon grasshoppers to a greater or less extent. Of these according to Webster the following are the most important, quails, prairie chickens, sparrow hawk, Swanson hawk, loggerhead shrike, all cuckoos, all blackbirds, the cowbird, the catbird, the meadowlark, and the redheaded woodpecker.

Domestic Fowls.

Chickens will eat a large number of grasshoppers and thrive upon them. Turkeys are very fund of grass-

hoppers and a drove of turkeys will keep a large field free from 'hoppers.

Other animals.

Snakes, lizzards, toads, skunks and pigs have been observed to catch grasshoppers and feed upon them.

Artificial Means of Control.

In applying preventive measures the destroying of the eggs seems to be the only one that proves to be practical. Many of the eggpods may be ~~when~~ destroyed ~~of~~ by exposing them to the weather and birds, by disking, harrowing or in some way cultivating the soil to a depth of 2 to 3 inches. All waste lands, roadsides, and other places that may be reached should be cultivated during the winter or early spring. Alfalfa fields have been ~~fo~~ turned to profit by such cultivation. Not only are the grasshopper eggs destroyed or exposed but the yield of alfalfa is often increased to quite an extent. If everyone would cultivate their waste places, alfalfa fields and other accessible fields ~~meet~~ a large proportion of the eggs would be destroyed.

After the grasshoppers have hatched from the eggs one must resort to other methods. Of these measures of control the most practical and important one will be discussed, ~~the Hopperdozer~~.

1. The Hopperdozer

The use of the hopperdozer, although practical and effective, is limited. It can be used only in such fields as alfalfa and other low crops. In the beetfields it does not prove very satisfactory and in the cornfields it can not be used after the corn has reached a height of 20 inches or more. Neither can it be used in grain after the grain has headed out. In alfalfa fields however I have observed very effective work with the hopperdozer.

Especially good results may be obtained, if, at the time when the crop is cut, strips of alfalfa 6-15 feet wide are left standing at intervals of 50 to 75 yds. The hoppers collect on these strips and with several trips back and forth with the hopperdozer most of the hoppers are caught. This methods of leaving strips is also very effective and economical in poisoning. The strips may be cut down in a day or two after the poisoning or using the hopperdozer.

Construction of the hopperdozer.

The hopperdozer consists of a long narrow water-proof trough with a high back mounted on runners so as to be drawn by one or two horses. The trough is made 12-16 feet long, 18-24 inches wide, 3-4 inches deep in front and a little higher in the back. Cross partitions should be placed in the trough or pan to prevent slopping and to keep the oil from running to one end when going over uneven ground.

The back top should be 3-4 feet high and is best made of sheet iron, but may be made of oil cloth on a wooden frame with the smooth side to the front. Canvas or burlap backs are not as satis-factory for the reason that the hoppers in jumping against the back will not slide down into the oil but cling to the back and jump away.

The pan is now ready to be placed upon runners. Three to five runners will be necessary. Boards should be fastened to the runners to protect the bottom of the pan from wear. The height of the run-ners depends somewhat upon the height of the crop. "It is important that there should be no timbers in front of the pan, so that the front line of the pan may come in contact with the grain passed over. The

insects then fall directly into the fluid". About 2 buckets of water are then poured into the pan and a half gallon of coal oil or any kind of crude oil poured on top. A horse is hitched to each end of the dozer and the dozer is drawn back and forth over the field. ~~Plate~~ Fig 66 shows how such a hopperdozer may be constructed.

Poisoned baits.

A number of poisoned baits have been recommended and tried but the one that we found to be the most satisfactory is known as the Poison bran mash. This bait is made as follows:

I

2½ lbs. Paris Green or White Arsenic.
50 lbs. Bran.
Mix these dry.

II

6 lemons, chopped up fine, rind and all.
4 quarts syrup.
5 gallons water.
Mix these three together thoroughly.
Mix I. and II., then add sufficient water to make a wet mash.

Caution:- Do not add water until the day the poison is to be distributed.

Early in the morning between 5 and 7 o'clock

this poisoned bran should be scattered broadcast in the infested areas. It is of great importance to get the poison out early as the hoppers eat it better when first beginning to feed.

The morning was found to be the best time to apply the mixture. It does not dry as fast then and the grasshoppers are more eager for food, and are, therefore, more easily attracted to it. When scattered broadcast, using three to five pounds of the mixture to the acre, the danger of poisoning fowls is eliminated.

The poisoned hoppers do not seem to take enough poison to affect the cannibalistic brethren who are wont to devour their poisoned kind.

Actual counts showed that after the bran mash once became dry it lost its attractiveness and thereby its effectiveness. This is another reason advanced for early morning application.

Since under ordinary weather conditions the bran dries out in about two hours, distributing the mash in little balls or piles was tried. It was found, however, upon experiment, that the sowing of the bran mash broadcast was more effective for the following reasons:

a. It eliminates all danger of poisoning fowls of stock.

b. Covers more than twice as much area and thereby reaches more hoppers.

c. After the outer surface of the bran-mash ball has once become dry it is not eaten even though the inside may still be moist.

d. With the same amount several applications may be made at intervals of two to four days thereby reaching more hoppers.

Observation counts showed that 40 to 60 per cent of the grasshoppers were killed with one application of the poison. A second application destroyed from 70 to 80 per cent of the grasshoppers.

Investigations in comparison with checked fields after the 25th of September showed that there were less than half as many living hoppers on the field where poison had been scattered than on checked fields where no poison had been applied.

It would seem almost impracticable to distribute poison in a green alfalfa field where there is abundance of feed for the hoppers and yet, from figures based on actual counts, about two hundred and

forty thousand grasshoppers were killed per acre with one application right in the midst of a large green alfalfa field. Poison for this experiment was scattered broadcast through the field, using four to five pounds to the acre at an actual cost of not over twelve cents per acre.

A more effective means, however, is the mowing of the field, leaving strips of standing alfalfa four to six feet wide and about seventy-five yards apart. The grasshoppers soon collect in these strips and are thus readily poisoned with small amounts of the bran mash or easily caught with the hopperdozer.

By the use of these means one of the largest alfalfa growers in the southwest was able to harvest three crops of alfalfa before the first of August where in a check field nearby only one crop was harvested in the same time and that the first crop.

Experimental Work on Attractiveness of Various Poison Mixtures.

Experiments to determine the attractiveness and effectiveness of a number of poison baits were made. The sites chosen for such experiments were bare of

vegetation but rich in green vegetation twenty-five to one hundred feet away.

For example beds of dried up ponds and unused bared irrigation ditches were used. In such situations the grasshopper could readily be observed descending from the food plants and marching directly to the poison.

The general mixture of bran, Paris green, and syrup was used, lemon, orange, anise oil, stale beer, and vinegar were added to separate portions respectively. On further experiment, plain bran and Paris green and plain bran with syrup were used to check results.

The object of these experiments was to find, if possible, a cheaper product to take the place of the expensive lemon, using vinegar, if possible.

Beginning with the lemon mixture and following it by anise oil, stale beer, and vinegar mixtures respectively, these were put out separately in a series of portions, about a teaspoonful in a place. Counts were then made of the number of hoppers attracted to the various baits and recorded as follows:

EXPERIMENT I.

Showing number of hoppers attracted to individual baits.

These counts were made at intervals of twenty to thirty minutes.

	Lemon			Anise Oil			Stale Beer			Vinegar		
Count No	1	2	3	1	2	3	1	2	3	1	2	3
Pile No 1	11	15	3	1	8	1	3	7	6	1	7	0
" " 2	8	14	2	4	11	2	5	7	0	4	6	0
" " 3	8	6	0	1	6	3	3	4	0	4	3	0
" " 4	4	9	7	3	3	3	3	2	0	3	2	0
" " 5	7	4	1	3	1	0	3	2	0	2	4	0
" " 6	5	4	0	4	1	1	3	1	0	5	4	1
" " 7	6	6	0	6	4	0	2	0	0	2	5	0
" " 8	2	8	1	9	1	1	3	3	0	2	2	1
" " 9	12	11	2	3	2	0	6	0	1	1	1	1
" " 10	8	3	7	3	3	1	2	4	0	0	1	0
" " 11	2	6	5	5	5	6	2	0	4	2	4	10
Total	73	86	28	36	45	17	35	30	5	26	39	13

Total number of hoppers attracted by various baits:

Lemon,	187	stale beer,	70
Anise oil	98	Vinegar,	78

The third count shows the comparatively small number of hoppers attracted after the bait had dried out.

EXPERIMENT II.

This experiment was made in the alfalfa stubble along the edge of a field that had not yet been cut.

The table again shows the number of hoppers attracted to individual baits.

Counts made at intervals of twenty to thirty minutes.

	Lemon		Anise Oil		Stale Beer		Vinegar		Plain Mixture		Plain Syrup	
Count No	1	2	1	2	1	2	1	2	1	2	1	2
Pile No 1	3	1	5	0	3	1	4	1	6	2	4	1
" " 2	12	4	6	3	1	3	2	0	9	4	7	0
" " 3	5	4	3	1	6	4	4	1	4	4	8	2
" " 4	6	4	8	7	6	2	4	0	4	1	6	1
" " 5	11	2	6	1	4	4	3	2	9	1	6	2
" " 6	9	3	8	3	3	0	2	1	2	1	7	3
" " 7	7	5	5	3	3	2	4	4	4	3	7	1
" " 8	10	5	5	4	5	1	1	1	6	2	5	3
Total	63	28	46	22	31	17	24	10	44	18	50	13

Total number of hoppers attracted by various baits:

Lemon, 91
Anise oil, 68
Stale beer, 48
Vinegar, 34
Plain mixture, 62
Plain syrup, 63

The plain mixture column contains only bran, Paris green, and water. The last column contains syrup in addition to the plain mixture. These were put out as checks.

EXPERIMENT III.

This experiment was made at same time and of the same mixtures as No. 2, but placed on bare ground near green vegetation.

	Lemon		Anise Oil		Stale Beer		Vinegar		Plain Mixture		Plain Syrup	
Count No	1	2	1	2	1	2	1	2	1	2	1	2
Pile No 1	4	11	7	8	3	3	9	4	8	3	7	1
" " 2	12	6	7	2	3	4	3	2	13	4	3	3
" " 3	6	4	7	7	5	4	8	6	9	3	8	2
" " 4	5	1	9	4	3	2	4	3	6	6	3	4
" " 5	2	3	3	0	3	2	3	2	3	4	4	2
" " 6	8	4	6	4	6	3	7	3	12	5	4	3
" " 7	16	11	6	6	3	2	10	2	7	5	3	3
" " 8	12	8	8	5	3	4	5	1	4	6	9	5
	65	48	53	36	29	24	49	23	62	36	41	23

Total number of hoppers attracted by various bates;

Lemon, 113
Anise oil, 89
Stale beer, 53
Vinegar, 72
Plain mixture, 98
Plain syrup, 64

EXPERIMENT IV.

These mixtures were put out in the center of an irrigating ditch, eight to ten feet away from all vegetation.

	Lemon			Anise Oil			Stale Beer			Orange			Vinegar			KCn		
Count No. 1	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Pile No. 1	10	9	6	1	6	5	9	8	8	3	5	2	1	4	7	0	0	0
Pile No. 2	5	5	3	4	6	3	3	4	6	4	1	2	4	6	2	0	0	0
Pile No. 3	9	8	3	4	2	6	2	2	3	6	9	3	1	6	3	1	1	0
Pile No. 4	7	4	2	6	4	1	2	3	1	7	2	3	7	5	1	0	0	0
Pile No. 5	2	1	1	6	9	6	2	2	4	7	5	3	3	4	5	0	0	1
Pile No. 6	8	14	9	2	3	2	15	7	10	4	2	2	14	6	5	0	0	0
Pile No. 7	12	8	8	8	6	3	15	7	5	15	4	5	17	9	7	0	0	0
Pile No. 8	23	14	7	10	12	5	12	14	5	21	10	1	10	8	5	0	0	0
Pile No. 9	14	9	7	7	4	5	21	7	5	5	4	6	26	14	6	0	0	0
Pile No. 10	8	18	4	10	13	2	17	13	5	15	5	3	11	5	3	0	0	0
Pile No. 11	26	7	6	17	11	2	12	4	3	3	10	4	2	15	4	0	0	0
Pile No. 12		18	9		10	4		16	8		7	5		5	4		1	1
Pile No. 13		8	7		4	2		8	2		8	3		6	2		0	1
Pile No. 14		6	4		11	5		10	1		8	3		9	4		0	0
Pile No. 15		7	5		5	3		7	3		5	2		7	3		0	0
Pile No. 16		8	5		8	3		8	5		3	9		8	1		0	0
Pile No. 17		15	8		4	2		15	2		4	3		2	1		0	0
Pile No. 18		18	9		9	4		12	6		7	6		4	2		0	0
Pile No. 19		16	3		4	2		10	10		11	2		4	2		0	0
	124	193	106	75	131	65	110	157	92	90	110	67	95	127	67	1	2	3

Total number of hoppers attracted by various baits;

Lemon, 423
Anise oil, 271
Stale beer, 359
Orange, 267
Vinegar, 284
KCn, 6

EXPERIMENT V.

	Lemon		Anise Oil		Stale Beer		Orange		Vinegar		Plain		Plain Syrup	
Count No. 1.	1	2	1	2	1	2	1	2	1	2	1	2	1	2
Pile No. 1...	4	4	6	1	11	1	3	1	6	2	12	2	9	0
Pile No. 2...	6	4	5	2	5	3	2	1	7	1	11	2	8	4
Pile No. 3...	10	6	4	2	8	3	2	3	3	2	8	3	13	2
Pile No. 4...	4	5	4	0	6	3	2	1	2	1	2	1	3	2
Pile No. 5...	5	3	6	2	5	5	4	1	6	4	3	2	10	3
Pile No. 6...	7	4	7	2	6	9	7	2	11	2	5	2	8	2
Pile No. 7...	13	5	6	2	2	2	6	2	4	1	13	4	16	6
Pile No. 8...	12	5	10	5	3	2	2	2	5	2	8	1	4	3
Pile No. 9...	9	1	8	3	8	5	3	4	3	5	4	1	7	I
Pile No. 10..	18	8	4	3	5	1	2	4	2	0	19	6	16	7
Pile No. 11..	11	4	1	3	2	2	7	5	2	7	5	1	7	1
Pile No. 12..	8	2	3	5	11	5	7	0	14	0	5	4	6	2
Pile No. 13..	16	5	7	4	5	1	9	4	6	1	4	2	5	1
Pile No. 14..	5	2	3	1	10	1	10	3	6	1	7	3	6	3
Pile No. 15..	2	5	8	2	9	6	7	4	5	3	9	3	14	1
Pile No. 16..	3	2	3	0	4	2	4	1	9	1	4	5	4	0
Pile No. 17..	5	1	4	5	6	2	2	2	1	2	6	2	9	2
	137	66	89	42	106	53	79	40	91	35	125	44	145	40

Total number of hopper attracted by various baits:

Lemon, 203
Anise oil, 131
Stale beer, 159
Orange, 119
Vinegar, 126
Plain mixture, 169
Plain syrup, 185

In this count the additional ingredients added to plain bran poison mash made no appreciable difference in the attractiveness of the bait. The potassium cyanide was tried in place of Paris green, but proved to be a complete failure. The hoppers would not eat the bait containing KCn.

SUMMARY OF PRECEDING DATA.

The lemon, therefore, seems to be about 26.5 per oent more effective than any of the other ingredients tried. As the foregoing experiments show, however, very good results can be obtained with the plain bran Paris green mash alone.

All the above experiments show that the grasshopper has a keen sense of smell and is easily attracted to the bait put out for it.

In one instance a little of the mixture(about a teaspoonful) containing the lemon in it, was placed in the middle of the road where no vegetation was present and the distance measured from which the hoppers were attracted. Several minutes after the bait had been put out, the hoppers were seen leaving the thistles and crawling for their newly prepared breakfast. Soon the congregation around the "table" numbered between sixty and seventy. A photograph was

taken of the "boarders coming for breakfast" but many of them were scared away while a number of the others turned "right about face".

The distance between the bait and a large thistle from which twelve to sixteen hoppers came was then measured and found to be fifty feet. It seem remarkable that the sense of smell should be so keenly developed in the grasshopper.

Effect of Poison Bran Mash on birds, chickens, turkeys, stock, bees, etc.

When the poison bran mash is scattered thinly and evenly as directed the danger of poisoning fowls and stock is practically eliminated. In our experience we have never found any dead birds or dead chickens as a result of feeding on the bran mash. Although the birds undoubtedly do feed on the bran to some extent, they do not receive enough poison to hurt them. Should the bran mash however be made too wet so it will clog and scatter in bunches where birds can eat it by the mouthfuls they may take enough poison to kill them.

In a good many instances where we scattered poisoned bran in the lawns, gardens and orchards where the chickens, large and small, had free access to the scattered bran as well as to the poisoned grasshoppers but in no instance did we find any chickens dead or sick as a result of the poison. Little chicks were seen picking up flakes of the poisoned bran here and there without any apparent effect.

One farmer had scattered the poisoned bran all through his yard and garden where the chickens were allowed to run loose. About 3 or 4 days after the poison had been scattered I visited the place and found the ground literally covered with dead grasshoppers, in places they were two and three deep; there was also a good sprinkling of dried poisoned bran left on the ground and yet none of the chickens seemed to have been affected by taking either the poison or the poisoned grasshoppers. The wife of the farmer however said that several of their young turkeys had been killed by eating the poison or poisoned 'hoppers.

As far as the stock is concerned there is no danger of poisoning from the bran scattered in the

fields. Care should be taken however that the stock does not have access to the mixture. Not enough of the poison will adhere to the vegetation to endanger it either for pasture use or as a hay crop.

Effect of Poison bran mash on bees.

During the experiments with the poison the question arose whether or not the bees, on account of the lemons and syrup used might not be attracted to the poison and eat enough to kill them. Mr. G. H. Vansell of the department of Entomology here conducted a good many experiments to determine whether the bees were attracted to the poison bran mash. He found that the bees would not voluntarily go to the poison bait and eat it, and that the danger of poisoning bees is very slight. The following I have taken from his field notes. The bees died after eating the mash. This was proven by actual experiment. The mash was placed upon the running board of the hive where the bees were bound to notice.it. They did not seem to scent the bait at all, but after running against it they would stop and lap at it quite greedily, then start off, but return presently and lap at it

some more as if they hated to leave. However even in this conspicuous place there were but few bees that were observed to eat the poison, probably 15 during the course of hour. Where the mash was placed a few feet away from the hive I did not notice a single bee bother the bait. Again some bees were caught in a bell jar and this was placed over some of the poison. After a while the bees came down and ate of the sweet mixture.

I also placed poison in a sweet clover patch which was in bloom. There were a good many bees present but I did not observe a single bee touching the mash. The bait was also placed among fallen rotten peaches and in open places with the same negative results.

Then lastly I took the poison and scattered it in bunches among 38 stands of bees. After this was done I helped rob the bees. Even under these disturbances, which ordinarily makes them very anxious to rob, I observed but a single bee eating of the mash. All these attempts at feeding the bees were repeated in the morning, at noon, and in the evening with the same results. From these experiments there-

more it seems that there is no danger to the bees from using the poisoned bran mash for grasshoppers.

OVIPOSITION.

The egglaying habits of the grasshoppers are essentially the same. A rather hard place is chosen by the female grasshopper and with the ovipositor (the four horn like points) she drills a hole into the ground to a depth of from 1½ to 2 inches, the abdomen often being stretched to at least twice its natural length. As soon as the hole is drilled a small amount of white frothy substance is placed at the bottom and then the eggs are laid. The number of eggs laid in one hole varies from 50-80 but may at times reach as high a number as 120. The most common places chosen for oviposition are the roadsides, alfalfa fields, bare irrigating ditches, pasture lands where they occur near cultivated fields and other compact places. In the summer and fall of 1913 during the extreme hot and dry weather the females seemed to prefer a shady place and deposited their eggs among the vegetation.

More eggpods were found in the ground on the north side of sweet clover plant, Melototus alba, than any other place. Buffalo grass pastures were very common places for oviposition. Special attention was given to the position of the abdomen relative to the head of the insect. During oviposition the female is very quiet and easily caught and held in the position assumed. In order to get a photograph I took a bottle containing about an ounce of commercial prussic acid (HCn) to which had been added a few small crystals of Potassium cyanide (KCn) and while holding the insect in position I placed a few drops of the liquid on the body of the insect which in every case died in less than a minute without changing the position of the body or withdrawing the abdomen from the hole. The earth was then carefully removed from one side until the hole and abdomen were exposed. In this position the photograph was taken as shown in Fig. 7/___.

The relative position of the abdomen to the head was noted in about 21 M. differentialis, 10 or 12 bivitattus, 1 Dessosteiria sp. (Dec. 2, '13.) and about 30 M. atlanis (Oct. 1914). In every case the

abdomen had a decided backward tilt, and not with a recurved position as has been shown in all texts and papers, except those of Milliken[1] and J. S. Hunter[2]. The grasshoppers, M. differentialis and M. bivitattus were not observed ovipositing in large numbers till the latter part of September and the first of October.

1 In the Journal of Economic Entomology, Vol. 5, No. 2, p. 232, 1913, Milliken records the correct mode of oviposition of M. bivittatus, D. carolina, and S. shoshone.

2 In California Bul. 170, 1905, J. S. Hunter reports the correct oviposition of M. differentialis.

SUMMARY.

Taxonomic.

The Melanopli of Kansas number thirty-nine species which are included in six genera. The following table shows the distribution of the species among the genera.

Genus	Species.
1. Hypochlora.	1
2. Campylacantha.	3
3. Hesperotettix	3
4. Aeoloplus.	2
5. Melanoplus.	29
6. Phoetaliotes.	1
Total.	39

The greater number of specimens have been collected in the central and western part of the state between the years 1909 and 1914. Campylacantha vivax, Melanoplus scitus, and Melanoplus discolor are now reported from Kansas for the first time.

The females, particularly of the genus Melanoplus are very difficult to classify and unless they are found with the males cannot always be placed with the

right species. The greatest variations in individuals of the same species are the color variations. These variations depend upon the time when the insect was taken, (they are much lighter shortly after the last molt than later on) the method of preservation etc.

All species of Melanopli found in Kansas are native to the state. The Rocky Mountain locust M. spretus the only migratory representative has not been found in Kansas for twenty years or more. It is now apparently extinct here.

Biologic.

The olfactory sense is very keenly developed in the grasshopper. Experiments in the field showed that the insects detected the poisoned bait as far as fifty feet away.

The method of oviposition of the female is very much the same in all the species. A rather firm place is chosen and from 30 - 100 eggs are deposited. In every case where the females were dug up during the act of oviposition the abdomen was found to have a decided backward tilt and was not curved under the body of the insect.

Economic
~~Taxonomic~~.

The Melanopli include most of the economically important grasshoppers, M. differentialis, M. bivittatus, M. atlanis and A. regalis do more damage than all other species put together. The most important enemies of the grasshoppers are: several species of flies, beetles, birds, chickens, turkeys and fungus and bacterial diseases.

To prevent the increase of Grasshoppers the eggs should be destroyed in winter or early spring by discing the fields. For control measures the hopperdozer does very efficient work where it can be used readily. The poison bran mash has been found to be the most satisfactory way of controlling the grasshoppers, and when applied as directed the danger of killing fowls and other animals is eliminated.

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Webster, F.M.-- The Grasshopper Problem and Alfalfa Culture, Farmers' Bul. 637, U. S. Department of Agriculture, pp. 1-10, January, 1915.

Map of Kansas showing counties where grasshoppers have been collected. The X's represent the number of species taken in each County.

Fig. 1. Tegmina of Melanoplus bivittatus.

Fig. 2. Tegmina of Melanoplus differentialis.

Fig. 3. Tegmina of Hesperotettix speciosus.

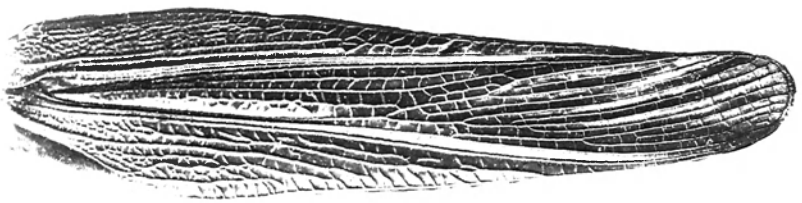

Fig. 1

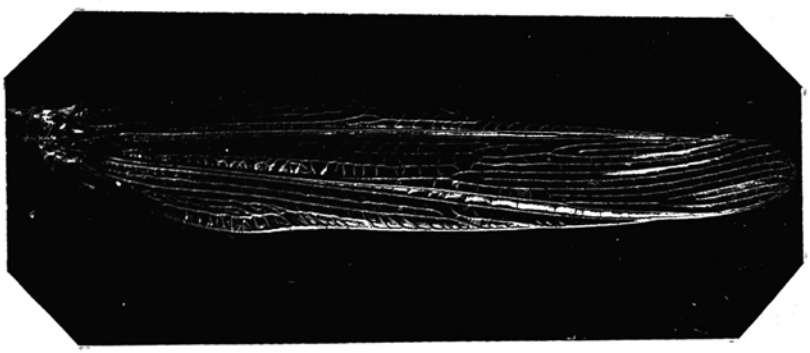

Fig. 2

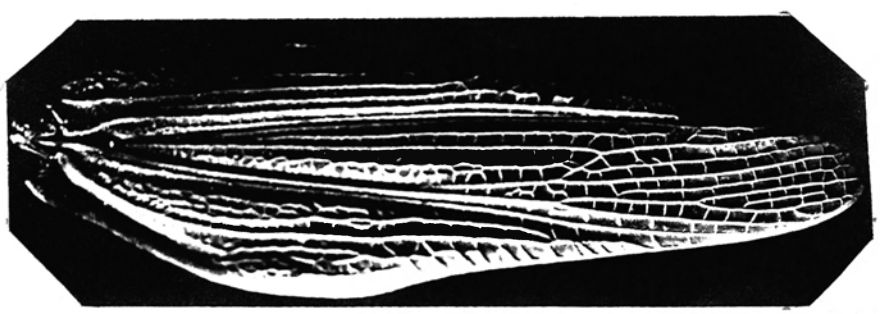

Fig. 3

Fig. 4 & 5. Hypochlora alba.

Fig. 6 & 7. Campylacantha olivacea.

Fig. 8 & 9. Hesperotettix viridis.

Fig. 10 & 11. Hesperotettix pratensis.

Fig. 12 & 13. Hesperotettix speciosus.

Fig. 14 &15. Aeoloplus regalis.

Fig. 16 & 17. Melanoplus lakinus.

Fig. 18 & 19. Melanoplus discolor.

Fig. 4

Fig. 5

Fig. 6

Fig. 7

Fig. 8

Fig. 9.

Fig. 10

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Fig. 13

Fig. 14

Fig. 15

Fig. 16

Fig. 17

Fig. 18

Fig. 19

Fig. 20 & 21. Melanoplus scudderi.

Fig. 22 & 23. Melanoplus occidentalis.

Fig. 24 & 25. Melanoplus regalis.

Fig 26 & 27. Melanoplus bowditchi.

Fig. 28 & 29. Melanoplus elongatus.

Fig. 30 & 31. Melanoplus glaucipes.

Fig. 32 & 33. Melanoplus scitus.

Fig. 34 & 35. Melanoplus atlanis.

Fig. 20

Fig. 21

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Fig. 29

Fig. 30

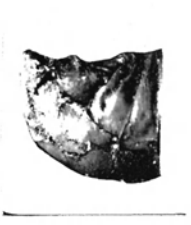

Fig. 31

Fig 32

Fig. 33

Fig 34

Fig. 35

Fig. 36 & 37. Melanoplus plumbeus.

Fig. 38 & 39. Melanoplus femur-rubrum.

Fig. 40 & 41. Melanoplus bispinosus.

Fig. 42 & 43. Melanoplus angustipennis.

Fig. 44 & 45. Melanoplus impiger.

Fig. 46 & 47. Melanoplus packardii.

Fig. 48 & 49. Melanoplus foedus.

Fig. 50 & 51. Melanoplus conspersus.

Fig. 36

Fig. 37

Fig. 38

Fig. 39

Fig. 40

Fig. 41

Fig. 42

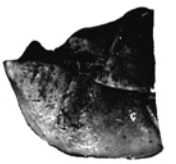

Fig. 43

Fig 44

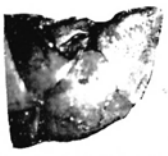

Fig 45

Fig 46

Fig 47

Fig 48

Fig. 49

Fig 50

Fig. 51.

Fig. 52 & 53. Melanoplus minor.

Fig. 54 & 55. Melanoplus luridus.

Fig. 56 & 57. Melanoplus differentialis.

Fig. 58. &59. Melanoplus bivittatus.

Fig. 60.& 61. Phoetaliotes nebrascensis.

Fig. 52

Fig 53

Fig. 54

Fig 55

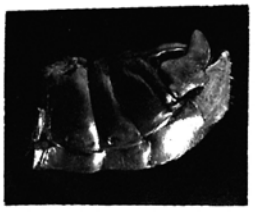

Fig 56

Fig 57

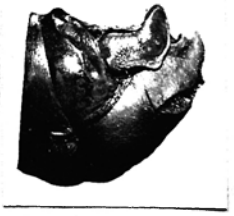

Fig 58

Fig. 59

Fig 60

Fig 61

Fig. 62. Melanoplus foedus showing two perfect median ocelli.

Figures 63,64,& 65. Melanoplus bispinosus showing different shapes of the cerci in the same specimen.

Fig. 62

Fig. 63

Fig 64

Fig. 65

Fig. 66. Plan for Construction of the Hopperdozer.

Fig. 67. Hopperdozer at work in the alfalfa field.

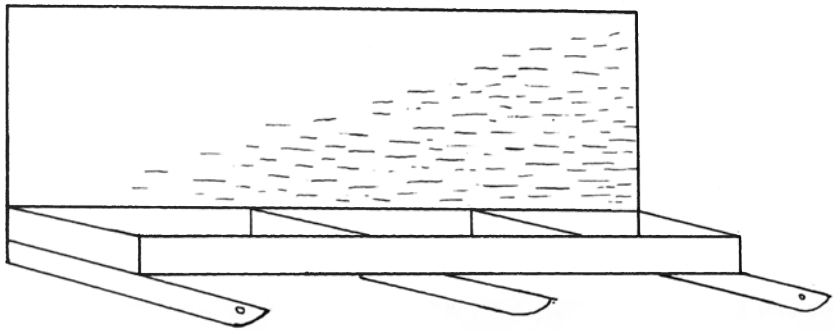

Fig. 66

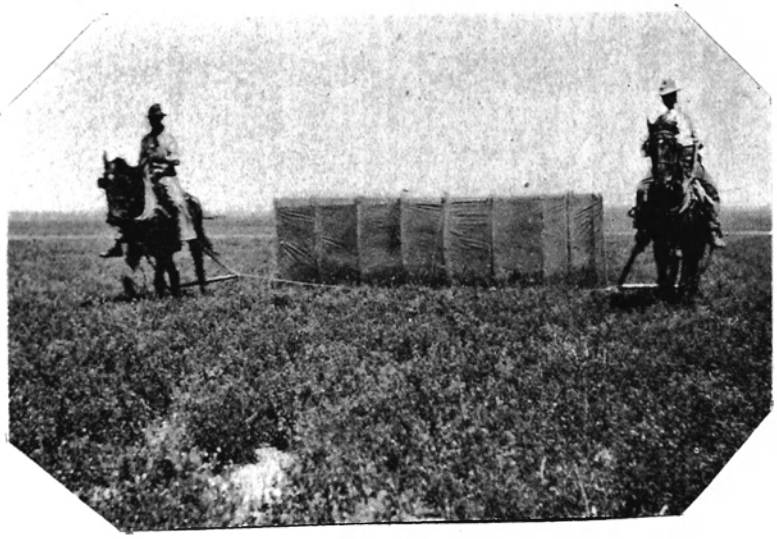

Fig. 67

Fig. 68. A bunch of grasshoppers caught in several rounds with the hopperdozer.

Fig. 69. An unused irregation ditch used in carrying on experiments with different poison mixtures. The grasshoppers are feeding on the remnants of the poison left on the cans.

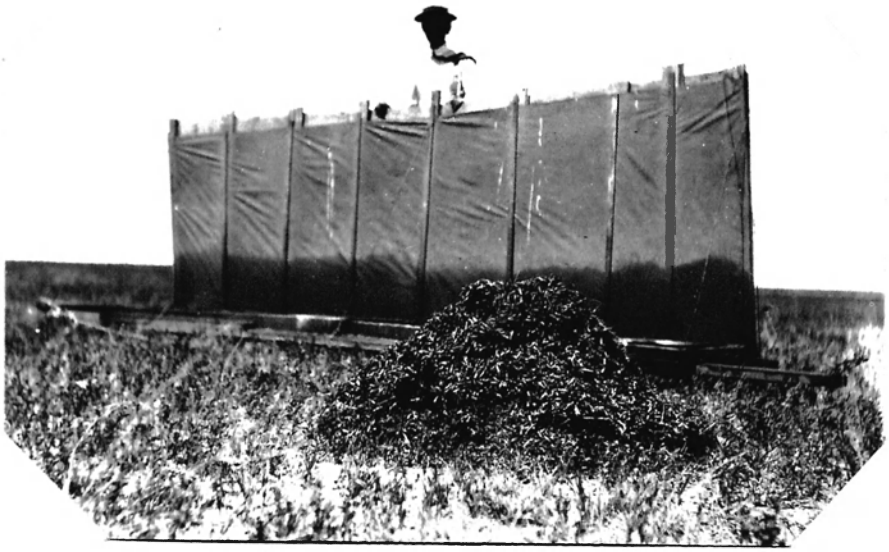

Fig. 68

Fig. 69

Fig. 70. Grasshoppers attracted to a little of the poison mixture.

Fig. 71. Melanoplus differentialis (female) ovipositing.

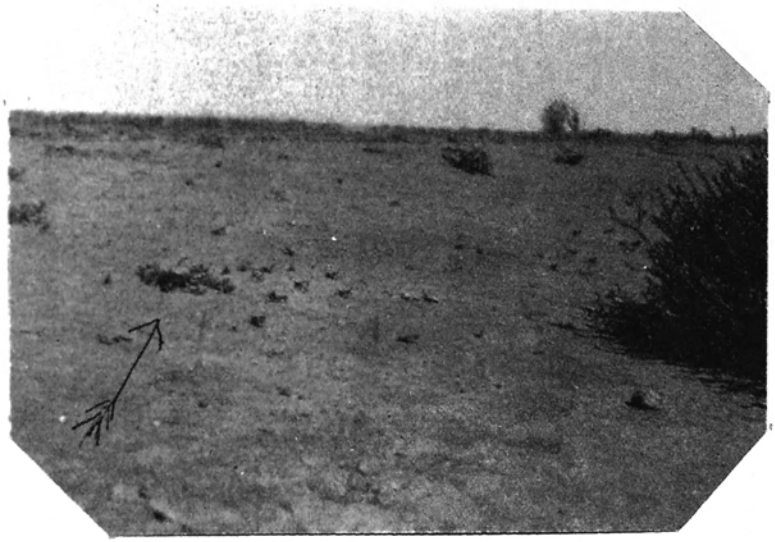

Fig. 70

Fig. 71